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# DAVID W. TAYLOR NAVAL SHI RESEARCH AND DEVELOPMENT CENTER



A GUIDE TO USE OF THE XWAVE PROGRAM: PART II -SCATTERING OF SOUND WAVES FROM RIGID STRUCTURAL SURFACES

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COMPUTATION, MATHEMATICS, AND LOGISTICS DEPARTMENT RESEARCH AND DEVELOPMENT REPORT

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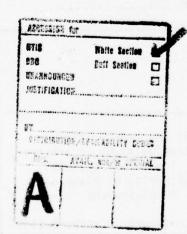
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#### ABSTRACT

This report reviews a generalized formulation of the steady-state boundary-value problem for scattering of infinite plane waves by an arbitrary closed rigid surface immersed in an infinite fluid. The normal velocity distribution generated over the closed surface by scattering of plane waves can also be interpreted as the boundary condition of an equivalent steady-state radiation problem. The numerical solution of rigid surface scattering problems is therefore obtainable by a simple extension of capabilities of the XWAVE program. The additional data required by XWAVE for rigid-surface scattering applications and several sample calculations are presented.

#### FORMULATION OF BOUNDARY-VALUE PROBLEM FOR RIGID-BODY SCATTERING

Part I<sup>1</sup> of this documentation described a numerical method for obtaining the radiated pressure field external to the surface of a structure vibrating in an ideal, infinite fluid. This problem is mathematically posed by the wave equation with attendant boundary conditions at infinity and on the structural surface.<sup>1</sup> It is well known<sup>2,3</sup> that boundary-value problems such as the one describing sound pressure from submerged vibrating surfaces can also be interpreted as formulating the

Henderson, F.M., "A Guide to Use of the XWAVE Program: Part I - Radiated Pressures From Vibrating Structures," DTNSRDC Report 77-0041 (Jun 1977).

<sup>&</sup>lt;sup>2</sup> Chertock, G., "Integral Equation Methods in Sound Radiation and Scattering from Arbitrary Surfaces," NSRDC Report 3538 (Jun 1971).

Junger, M.C., and D. Feit, "Sound, Structures and Their Interaction," MIT Press, Cambridge, Massachusetts, and London, England (1972).

sound field produced when trains of pressure waves impinge on and are scattered by structural surfaces.

To obtain this alternative formulation, the vibrating structure considered in the earlier report is replaced by a rigid-body surface (see Figure 1) on which a time-independent succession of infinite plane waves impinges.

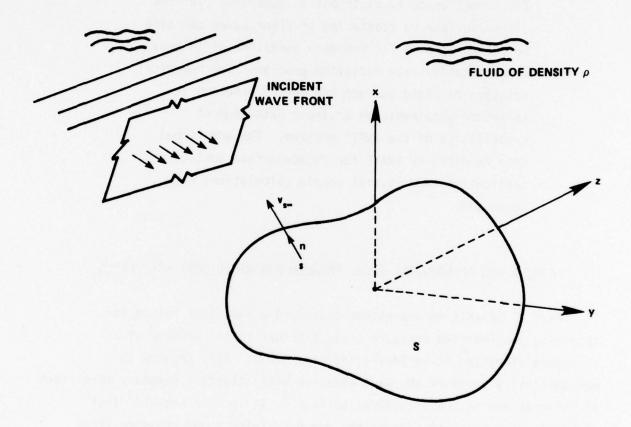


Figure 1 - Rigid-Body Scatterer Immersed in an Infinite Fluid

It is of practical interest to consider plane wave incidence since in applications such as active sonar detection problems the wave source is sufficiently far from the scattering obstacle that the radius of curvature of the wave fronts near the obstacle can be considered essentially infinite. In addition, the decrease in pressure from geometric spreading

of the incident wave over the scattering surface can be neglected.  $^{3}$ 

The total pressure (above ambient) in the field is the sum of the incident and scattered wave pressures,

$$p(\underline{z}) = p_{\underline{i}}(\underline{z}) + p_{S_{\infty}}(\underline{z})$$
 (1)

where  $\underline{z}$  denotes field points and  $p_{S\infty}$ , in the notation of Junger and Feit, denotes field pressures scattered from rigid (infinite impedance) boundaries. Since the total pressure p must satisfy the wave equation, the scattered pressure must also satisfy it,

$$\nabla^2 p_{S_{\infty}}(\underline{z}) + k^2 p_{S_{\infty}}(\underline{z}) = 0$$
 (2)

k is the wave number of the incident pressure wave; k  $\equiv \omega/c$  in which

 $\omega$  is the angular frequency of the incident pressure wave

c is the speed of sound in the fluid

The presence of the rigid boundary requires the sum of the fluid particle velocities in the incident and scattered waves at any point on the body surface to be zero,

$$\frac{\partial p_{i}(s)}{\partial n} = -i\omega\rho v_{i}(s) = i\omega\rho v_{s\infty}(s) = -\frac{\partial p_{s\infty}(s)}{\partial n}$$
(3)

where, referring to Figure 1,

s is a point on the closed surface S of arbitrary shape

n is the direction normal to the structural surface at s

 $v_i(s)$  is the incident fluid particle velocity normal to the structural surface at s

 $\boldsymbol{v}_{S^{\infty}}(s)$  is the scattered fluid particle velocity normal to the structural surface at s

p<sub>i</sub>(s) is the incident pressure on the structural surface at s

 $\boldsymbol{p}_{\boldsymbol{S}^{\infty}}(\boldsymbol{s})$  is the scattered pressure on the structural surface at  $\boldsymbol{s}$ 

ρ is the fluid density

The boundary condition at infinity is

$$p_{S\infty}(\underline{z}) \approx \frac{e^{ik|\underline{z}|}}{|\underline{z}|}; |\underline{z}| \to \infty$$
 (4)

where z denotes a point in the fluid.

Equations (2), (3), and (4) then give the alternative boundary-value problem to be solved for rigid body scattering. When these equations are compared with their counterparts for a vibrating body, (Equations (1), (2), (3) of DTNSRDC Report 77-0041) it is seen that the only distinction between the radiation problem and the rigid-body scattering problem is the manner in which the surface boundary condition is interpreted.

#### GENERAL FORMULATION FOR THE BODY SURFACE BOUNDARY CONDITION

In order to perform rigid-body scattering calculations using XWAVE, a suitable representation for the normal surface boundary condition  $v_{\infty}(s)$  arising from an incident plane wave must first be obtained. Since a general direction of incidence is to be specified, it is convenient to utilize vector wave number notation. With this notation the steady-state incident pressure field is given by

$$p_{i}(\underline{z}) = P_{i}e^{i\underline{k}_{i}(\cdot)\underline{z}}$$
(5)

where  $\underline{k}_i$  is defined as a vector with magnitude equal to  $k_i$  and having x-, y-, z-components corresponding to the direction of wave incidence, and  $\underline{z}$  is a vector denoting a field point. Taking the partial derivative of  $p_i(\underline{z})$  in the direction normal (outward) to the surface S at s ( $\underline{z}$  = s) gives

$$\frac{\partial p_{i}(s)}{\partial n} = \frac{\partial P_{i}e^{\frac{i\underline{k}_{i}(\cdot)s}{\partial n}}}{\partial n} = \underline{\hat{n}} \cdot \nabla P_{i}e^{\frac{i\underline{k}_{i}(\cdot)s}{\partial n}} = i\underline{\hat{n}} \cdot \underline{k}_{i}P_{i}e^{\frac{i\underline{k}_{i}(\cdot)s}{\partial n}}$$
(6)

where  $\hat{\underline{n}}$  denotes a unit vector normal to S at s and pointing to the exterior of S. Substituting this result into Equation (3) then yields

$$i \hat{\underline{n}} \cdot \underline{k}_{i} P_{i} e^{i \underline{k}_{i} (\cdot) s} = i \omega_{\rho} v_{s_{\infty}}(s)$$
 (7)

Since the XWAVE formulation uses the nondimensional forms of pressure and

velocity

$$\frac{\overline{p}}{\overline{v}} = p/\rho c v_0 \tag{8}$$

where  $\mathbf{v}_0$  is an arbitrary velocity, dividing both sides of Equation (7) by  $i\rho c\mathbf{v}_0$  gives

$$\underline{\hat{\mathbf{n}}} \cdot \underline{\mathbf{k}}_{1} \overline{\mathbf{p}}_{1} e^{i\underline{\mathbf{k}}_{1}(\cdot)s} = k_{1} \overline{\mathbf{v}}_{s_{\infty}}(s)$$
 (9)

and finally the desired expression for the surface normal velocity resulting from time-harmonic infinite plane waves incident on S from a general direction,

$$\overline{v}_{S\infty}(s) = \frac{\hat{n} \cdot \underline{k}_{i} \overline{P}_{i} e^{i\underline{k}_{i}(\cdot)s}}{k_{i}}$$
 (10)

Since XWAVE is based on a numerical solution to the wave equation, a finite representation for  $\overline{v}_{S^\infty}(s)$  is used, as in the case of the radiation calculations, in which its values are defined only for points of a discretized model of the scattering surface S (see Figure 2 of DTNSRDC Report 77-0041).

#### XWAVE DATA FOR THE RIGID-BODY SCATTERING PROBLEM

Equation (10) shows that the data required to calculate  $\overline{v}_{s_{\infty}}$  are:

- 1. x-, y-, z-coordinates of  $\hat{\underline{n}}$
- 2. x-, y-, z-coordinates of vector wave number  $\underline{k}$ ;
- 3. x-, y-, z-coordinates of surface point s
- 4. magnitude,  $\overline{P}_i$ , of nondimensional incident pressure
- 5. magnitude,  $k_i$ , of  $\underline{k}_i$

Since items 1) and 3) are already included as part of XWAVE's "surface geometric data", <sup>1</sup> additional input facility is needed only for the remaining items. To accommodate items 2) and 4) a new data card is introduced with format as follows:

#### "INCIDENT PLANE WAVE DATA" CARD

Columns	Contents	Description
1-8	$\frac{k}{x}$ i <sub>x</sub>	x-component of $\underline{k}_{i}$
11-18	$\frac{k}{y}$	y-component of $\underline{k}_i$
21-28	<u>k</u> i <sub>z</sub>	z-component of $\frac{k}{i}$
33-40	P̄ i	Magnitude of nondimensional incident pressure wave, $\overline{P}_i = P_i/\rho cv_0$

Item 5) is entered in the space allotted to k (for radiation applications) on the "Miscellaneous Data" Card.  $^{\mbox{\scriptsize l}}$ 

DATA INPUT FORM (1) (see Part I of this documentation) is revised as shown in Appendix A to include the incident plane wave data card type and to indicate its position in the XWAVE data deck.

Two of XWAVE's program options (see Part I, section entitled DATA FORMATS) are augmented as follows:

# • "PROGRAM OPTIONS" CARD

Columns	Contents	Description						
13-16		OPT4: Selector for surface velocity						
		distribution						
		Velocity distribution is:						
	0005	Generated for plane wave incidence						
		upon the body surface. (Scattering						
		applications only)						
17-20		OPT5: Selector for radiation or						
		scattering applications						
	0000	Radiation calculations						
	0001	Scattering calculations						

The other options and types of data as well as data configurations to be used for scattering applications are the same as those previously described for use with radiation calculations (see DATA FORMATS $^1$ ).

#### SAMPLE CALCULATIONS

CALCULATION OF FAR-FIELD SCATTERED PRESSURES FROM A RIGID CYLINDER ILLUMINATED BY A PLANE WAVE NORMAL TO THE CYLINDER AXIS

An approximating analytic result  $^3$  is used for comparison with the numerical solution for this problem. The analytic approach extends results obtained  $^3$  for an infinite rigid cylinder that scatters a plane wave incident from the  $\phi=\pi$  direction (spherical coordinates) by restricting the scattering acceleration boundary condition of the infinite cylinder to a finite length 2L, Figure 2, and by taking the acceleration distribution equal to zero for |z| > L.

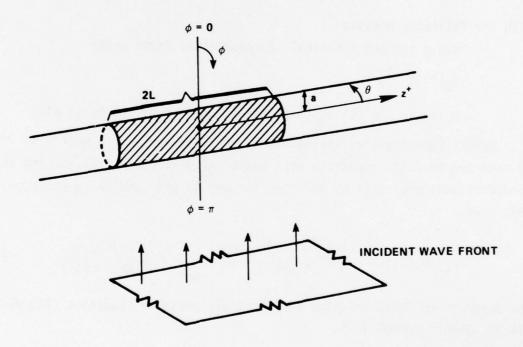


Figure 2 - Approximate Representation for Finite Cylinder Scattering of Plane Wave Incident Normal to Cylinder Axis

The acceleration for |z| < L is  $^3$ 

$$\ddot{w}(z,\phi) = \frac{kP_{i}}{\rho} \sum_{n=0}^{\Sigma} \varepsilon_{n} i^{n} J_{n}'(ka) \cos n\phi$$
 (11)

with the following notation $^3$ :

 $\boldsymbol{\epsilon}_n$  is the Neumann function, =1 for n=0; 2 for n>0

 $J_{n}(x)$  is the cylindrical Bessel function of the first kind

a is the cylinder radius

The far-field scattered pressure field is expressed as 3

$$p_{S^{\infty}}(R,\theta,\phi) = -\frac{2Le^{ikR}P_{i}j_{0}(kL\cos\theta)}{\pi R\sin\theta} \sum_{n=0}^{\Sigma} \frac{\varepsilon_{n}J'_{n}(ka)\cos n\phi}{H'_{n}(ka\sin\theta)}$$
(12)

with the following notation $^3$ :

 $R, \theta, \phi$  are the spherical coordinates of field point

$$j_0(x) = \frac{\sin x}{x}$$

 $H_n(x)$  is the cylindrical Hankel function of the first kind

Before Equation (12) is evaluated, it is convenient to modify it to make the results compatible with XWAVE calculations. Transforming to nondimensional pressures by dividing through by  $\rho cv_0$  and using Equation (8), gives

$$\overline{p}_{S\infty}(R,\theta,\phi) = -\frac{2Le^{ikR}\overline{p}_{i}j_{0}(kL\cos\theta)}{\pi R\sin\theta} \sum_{n=0}^{\Sigma} \frac{\varepsilon_{n}J'_{n}(ka)\cos n\phi}{H'_{n}(ka\sin\theta)}$$
(13)

The form of the XWAVE solution for far-field pressure (Equation (10) of DTNSRDC Report 77-0041) is

$$F(z) = \frac{i}{k} \overline{p}(z) \frac{4\pi |z|}{e^{ik}|z|}$$
 (14)

In this expression,  $\overline{p}(\underline{z})$  denotes nondimensional pressure at  $\underline{z}$ , where  $\underline{z}$  is the far-field point position vector. For the case of scattering,  $\overline{p}_{S^{\infty}}(\underline{z})$  will correspond to  $\overline{p}_{S^{\infty}}(R,\theta,\phi)$  in Equation (13). The following

form of Equation (13) is thus compatible with XWAVE:

$$F_{S^{\infty}}(z) = \frac{i}{k} \overline{p}_{S^{\infty}}(z) \frac{4\pi |z|}{e^{ik|z|}} = \frac{i}{k} \overline{p}_{S^{\infty}}(R,\theta,\phi) \frac{4\pi R}{e^{ikR}}$$

$$= -\frac{8iL\overline{p}_{i}j_{0}(kL\cos\theta)}{k\sin\theta} \sum_{n=0}^{\infty} \frac{\epsilon_{n}J_{n}'(ka)\cos n\phi}{H_{n}'(ka\sin\theta)} = F_{S^{\infty}}(\theta,\phi)$$
(15)

To illustrate the evaluation of Equation (15) the following data were used: cylinder radius a=1; cylinder half-length L=2; k=1; normalized incident pressure  $\overline{P}_i$ =1.

A FORTRAN program was written to perform the far-field pressure calculation. This program utilized a subroutine COMBES (PS-582A) from the Boeing Math Science Library to compute the cylindrical Bessel functions of first and second kinds,  $J_{\rm n}({\rm x})$  and  $Y_{\rm n}({\rm x})$ , for this evaluation. These in turn were used to obtain  $^4$ :

$$J_{n}'(ka) = -J_{n+1}(ka) + \frac{n}{ka} J_{n}(ka)$$

$$H_{n}(ka \sin \theta) = J_{n}(ka \sin \theta) + i Y_{n}(ka \sin \theta)$$

$$H_{n}'(ka \sin \theta) = -[J_{n+1}(ka \sin \theta) + i Y_{n+1}(ka \sin \theta)] + \frac{n}{ka} [J_{n}(ka \sin \theta) + i Y_{n}(ka \sin \theta)]$$

$$+ i Y_{n}(ka \sin \theta)]$$
(16)

Far-field pressures were computed around a polar great circle path (in a plane perpendicular to the incident wave) and an equatorial great circle path (in a plane parallel to the incident wave) on the surface of a large sphere ( $R \rightarrow \infty$ ) centered about the cylinder. The results are given in Table 1.

<sup>&</sup>lt;sup>4</sup> Hildebrand, F.B., "Advanced Calculus for Applications," (Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1962). (See in particular Chapter 4, Equations (92), (111).)

TABLE 1 - FAR-FIELD SCATTERED PRESSURES FROM FINITE, RIGID CYLINDER WITH INCIDENT PLANE WAVE NORMAL TO CYLINDER AXIS (ANALYTIC SOLUTION)

		F <sub>S∞</sub> (θ,φ) /	F <sub>s</sub> (θ,φ)	*  max		
φ°	θ°	Polar Circle	φ°	θ°	Equatorial	Circle
0	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 180	.3397 .2932 .2436 .1922 .1432 .1102 .1177 .1642 .2274 .2956 .3639 .4299 .4920 .5484 .5977 .6382 .6683 .6870 .6933 Symmetry (85°-0°)	90	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95	.3397 .3389 .3400 .3451 .3548 .3694 .3887 .4126 .4404 .4713 .5044 .5383 .5717 .6031 .6312 .6545 .6720 .6829 .6866	85°-0°)
180	180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85	.3397 .3821 .4265 .4756 .5295 .5865 .6442 .7001 .7523 .7998 .8421 .8793 .9112 .9383 .9604 .9776 .9900 .9975 1.000	270	180 : 0	Symmetry ( $\sum_{\infty} (\theta, \phi) \big _{\max} =$	

In order to obtain the numerical solution of this problem, the finite cylinder of length 2L (see Figure 2) is referenced to a Cartesian frame as shown in Figure 3,

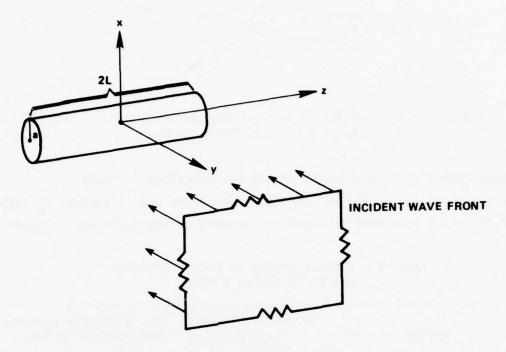


Figure 3 - Plane Wave Incidence Normal to Axis of Finite Cylinder

and the incident wave front (Figure 2) is reoriented to approach from the y<sup>+</sup> direction ( $\phi$  = 90°). The latter revision transforms the xz-plane symmetry of the surface velocity boundary condition resulting from x<sup>-</sup> (or  $\phi$  =  $\pi$ ) incidence to a particular pattern of yz-plane symmetry compatible with XWAVE's data input generator.

As a result of yz- and xz-plane symmetry in the cylinder geometry and velocity boundary condition, specification of the acoustic model for only one quarter of the cylinder surface is sufficient to enable the data generator to establish the total surface model. Figure 4 indicates subdivisioning of the quarter surface into "regions" (numbered) for subsequent generation of surface acoustic elements.

The data which specify the surface regions and the distribution of elements over each region (and the total body surface by reflection) are

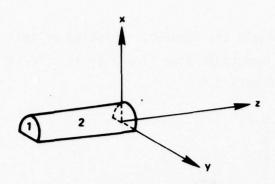


Figure 4 - Designation of Surface Regions on Portion of Finite Cylinder for First Sample Problem

prepared according to procedures previously described. Table 2 summarizes data for an initial surface model, A, and one refinement of this model, B, which were used to check convergence of the numerical solution.

TABLE 2 - SURFACE MODELS OF FINITE CYLINDER FOR FIRST SAMPLE PROBLEM

	Region	n	m	No. Basic Elements Σ n x m	No. Effective Elements Over Entire Surface 4(Σ n x m)
MODEL A	1* 2	6 12	9	}	648
MODEL B	1 2	6 12	15 15	} 270	1080

<sup>\*</sup> Ref. Figure 4

Numerical results for the surface modelings given in Table 2 are summarized in Table 3 and the results for the second model are compared in Table 4 and Figure 5 with results for the approximating analytic solution (Table 1). The data for XWAVE, prepared on the program's input forms, and computer output for the second calculation (Model B) are presented in Appendix B.

TABLE 3 - FAR-FIELD SCATTERED PRESSURES FROM FINITE, RIGID CYLINDER WITH PLANE WAVE NORMAL TO CYLINDER AXIS (XWAVE SOLUTION)

		F <sub>S∞</sub> (	θ,φ)//F <sub>s∞</sub> (θ	,φ) * max(	analyt	ic)	
	Ec	quatorial Ci	rcle			Polar Circ	le
φ°	θ°	Model 1	Model 2	φ°	θ°	Model 1	Model 2
270	0	.3813	.3766	0	0	.3813	. 3766
	5	. 3420	.3386		5	. 3830	. 3784
	10	. 3042	.3021		10	.3883	. 3837
	15	. 2684	. 2677		15	.3969	.3924
	20	.2363	.2369		20	.4087	.4042
	25	.2114	.2128		25	.4232	.4189
	30	.2000	.2012		30	. 4402	.4361
	35	.2086	.2080		35	. 4591	.4553
	40	.2390	.2355		40	. 4794	.4759
	45	. 2874	.2804		45	.5006	. 4974
	50	. 3476	.3371		50	.5219	.5191
	55	.4143	. 4005		55	.5428	.5403
	60	.4826	.4659		60	.5626	. 5605
	65	.5487	.5292		65	.5806	.5789
	70	.6086	.5869		70	.5963	.5949
	75	.6592	.6356		75	.6092	.6079
	80	.6975	.6726		80	.6187	.6176
	85	.7215	.6957		85	.6245	.6236
	90	.7296	.7035		90	.6265	.6256
	95)				95		
	: }	Symmetry (	85°-0°)		: }	Symmetry (8	35°-0°)
	180	Symmetry (	03 -0 )		180	Symmetry (C	55 -0 )
90	180	.3813	.3766	180	180		
	175	.4221	.4164		: }	Symmetry (	185°-0°)
	170	.4647	.4580		o )	Symmetry (	103 -0 /
	165	.5091	.5016		0 ,		
	160	.5553	. 5471				
	155	.6029	.5943				
	150	.6513	.6424				
	145	.6996	.6909				
	140	.7470	.7386				
	135	.7923	.7846				
	130	.8346	.8278				
	125	.8730	.8675				
	120	.9068	. 9026				
	115	.9356	. 9328				
	110	.9590	. 9576				
	105	.9771	.9769				
	100	.9899	.9907				
	95	.9975	.9989		* ,	5 /- N	14 0011
	90	1.000	1.002		1	$F_{s\infty}(\theta,\phi) _{max}$	= 14.8013
	85						
	: }	Symmetry (9	5°-180°)				
	0	•					

TABLE 4 - PERCENTAGE DIFFERENCES BETWEEN NUMERICAL AND ANALYTIC SOLUTIONS FOR FIRST SAMPLE PROBLEM

	Po	lar Circle		Equa	atorial Circle
φ°	θ°	% Difference	s* φ°	θ°	% Differences*
0	0 5 10 15 20 25 30 35 40 45 50 65 70 75 80 85 90	10.9 15.5 24.0 39.3 65.4 93.1 70.9 26.7 35.6 5.14 7.36 6.84 5.30 3.50 1.81 0.41 0.64 1.27	90	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90	10.9 11.7 12.9 13.7 13.9 13.4 12.2 10.3 8.06 5.54 2.91 0.37 -1.96 -4.01 -5.75 -7.12 -8.10 -8.68 -8.88
180	0 5 10 15 20 25 30 35 40 45 50 65 70 75 80 85 90	10.9 8.98 7.39 5.47 3.32 1.33 -0.28 -1.31 -1.82 -1.90 -1.70 -1.34 -0.94 -0.59 -0.29 -0.072 -0.071 0.14 0.20			
			* = Numeric	al Resul Analyti	t-Analytic Result x 100

Figure 5 - Far-Field Scattered Pressures from Finite, Rigid Cylinder with Incident Plane Wave Normal to Cylinder Axis. Comparison of Analytic and Numerical Solutions

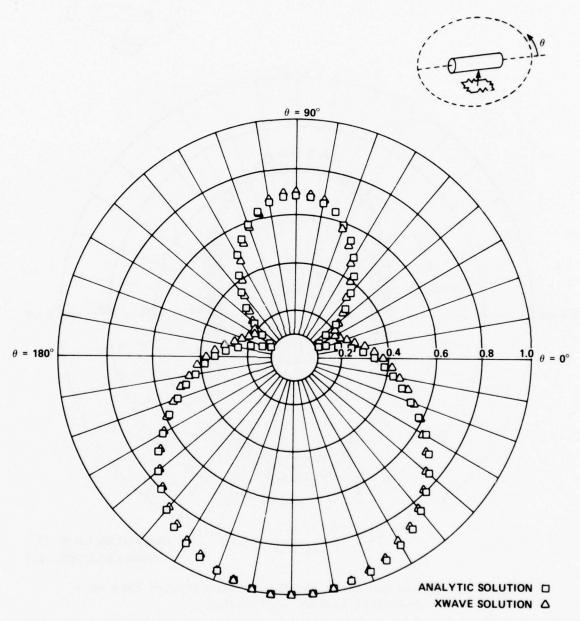


Figure 5a - Pressures Along the Polar Circular Path on a Spherical Surface at Infinity

Figure 5 (Continued)

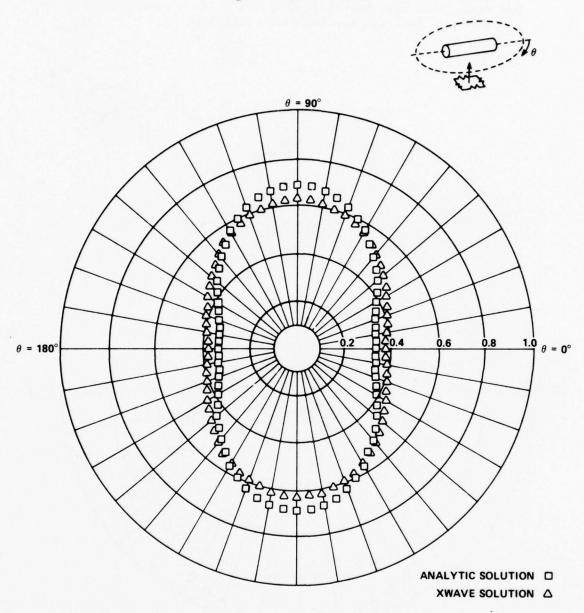


Figure 5b - Pressures Along the Equatorial Circular Path on a Spherical Surface at Infinity

CALCULATION OF FAR-FIELD SCATTERED PRESSURES FROM A RIGID CYLINDER ILLUMINATED BY A PLANE WAVE PARALLEL TO THE CYLINDER AXIS

The second sample problem illustrates the facility with which the direction of the incident wave and hence the velocity boundary condition for scattering can be varied by using the wave vector concept as implemented in XWAVE.

Instead of a plane wave incident normal to the axis of a cylinder (Figure 3), a wave propagating parallel to the z-axis from the  $\overline{z}$  direction is used, as shown in Figure 6. If the wave number is assumed to be 2 for this case, the components of the wave number vector are  $\underline{k}_i = 0$ ,  $\underline{k}_i = 0$ ,  $\underline{k}_i = 0$ . Although any direction in space could be as readily specified from the general expression for components,  $\underline{k}_{i_x} = 2\alpha$ ,  $\underline{k}_{i_y} = 2\beta$ ,  $\underline{k}_{i_z} = 2\gamma$ , where  $\alpha$ ,  $\beta$ ,  $\gamma$  are direction cosines of  $\underline{k}_i$ , the wave directed parallel to the z-axis generates a radially symmetric surface velocity boundary condition which in turn leads to shorter computer running times for the problem.

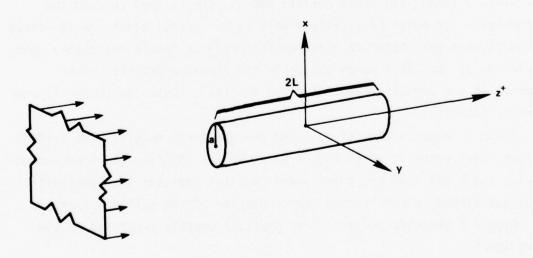


Figure 6 - Plane Wave Incidence Parallel to Axis of Finite Cylinder

The portion of the cylinder surface specified to XWAVE's data generator and the subdivision of this surface into regions used by the program in establishing surface element models are sketched in Figure 7.

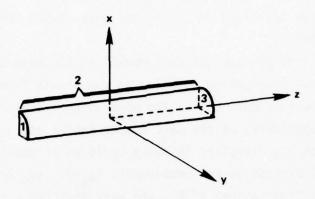


Figure 7 - Designation of Surface Regions on Portion of Finite Cylinder for Second Sample Problem

Table 5 summarizes three surface models, the initial one and two refinements, for which calculations were made. In all cases the far-field pressures were calculated at 2-degree intervals to insure reasonably good resolution of the lobes which appear in the pressure profile. Data preparation and computer output for the initial calculation (Model 1) are given in Appendix B.

Table 6 compares results obtained for the three models. The initial surface model results, which differ by at most 2.72% from the second model results and 2.94% from the third model results, indicate that the initial model was already a fairly good representation of the cylinder surface.

Figure 8 sketches the scattered pressure profile predicted by the third model.

TABLE 5 - SURFACE MODELS OF FINITE CYLINDER FOR SECOND SAMPLE PROBLEM

	Region	n	m	No. Basic Elements Σ n x m	No. Effective Elements Over Entire Surface 4(Σ n x m)
	1*	6	9		
MODEL 1	2	12	5	168	672
	3	6	9		
	1	6	16		
MODEL 2	2	12	5	252	1008
	3	6	16		
	1	6	9		
MODEL 3	2	24	9	324	1296
	3	6	9		

<sup>\*</sup> Ref. Figure 7

TABLE 6 - FAR-FIELD SCATTERED PRESSURES FROM FINITE, RIGID CYLINDER WITH INCIDENT PLANE WAVE PARALLEL TO CYLINDER AXIS. COMPARISON OF XWAVE RESULTS FOR THREE SURFACE MODELS.

	F <sub>S∞</sub> (θ)													
θ	Model 1	Model 2	Model 3	θ	Model 1	Model 2	Model 3							
0	8.07	8.21	7.91	92	4.01	4.04	4.00							
4	7.99	8.13	7.83	96	4.55	4.58	4.54							
8	7.76	7.89	7.59	100	4.66	4.68	4.66							
12	7.37	7.50	7.21	104	4.34	4.35	4.35							
16	6.85	6.96	6.69	108	3.64	3.64	3.66							
20	6.22	6.31	6.05	112	2.71	2.68	2.72							
24	5.52	5.60	5.37	116	1.84	1.79	1.83							
28	4.86	4.91	4.73	120	1.79	1.78	1.74							
32	4.37	4.39	4.26	124	2.72	2.75	2.64							
36	4.20	4.19	4.12	128	3.89	3.95	3.81							
40	4.38	4.37	4.34	132	4.98	5.05	4.90							
44	4.81	4.80	4.79	136	5.85	5.93	5.78							
48	5.29	5.30	5.28	140	6.47	6.55	6.41							
52	5.65	5.68	5.64	144	6.82	6.90	6.78							
56	5.75	5.80	5.74	148	6.94	7.00	6.91							
60	5.53	5.58	5.51	152	6.87	6.92	6.86							
64	4.94	5.00	4.92	156	6.66	6.69	6.66							
68	4.02	4.07	4.00	160	6.39	6.40	6.39							
72	2.84	2.87	2.82	164	6.09	6.10	6.10							
76	1.56	1.58	1.55	168	5.83	5.82	5.84							
80	0.98	0.960	0.967	172	5.62	5.61	5.63							
84	1.94	1.94	1.94	176	5.50	5.48	5.50							
88	3.10	3.11	3.09	180	5.45	5.44	5.45							

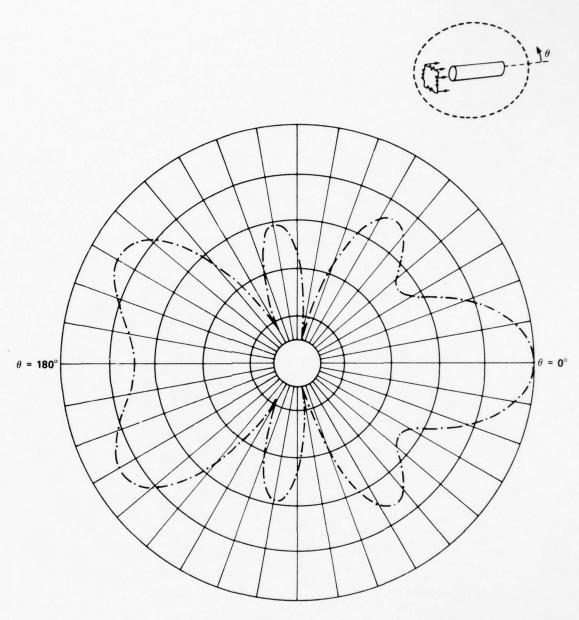


Figure 8 - Far-Field Scattered Pressures from Finite, Rigid Cylinder with Incident Wave Parallel to Cylinder Axis

APPENDIX A

AUGMENTED XWAVE DATA INPUT FORM (1)

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DATA INPUT FORM (1)

# APPENDIX B INPUT DATA AND COMPUTER OUTPUT FOR SAMPLE CALCULATIONS

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2.3362E-02	2.0362E-02	2.3362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.0362E-02	2.6180E-02	2.6180E-02	2.6180E-02	2.5180E-02	2.6180E-02	2.6180E-02	2.6180E-02	2.6180E-02	2.6180E-02
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2.9167E-31 5.8518E-01 -2.0000E+00	3.9033E-01 4.3350E-01 -2.0000E+00	4.7193E-01 3.4297E-01 -2.0000E+00	5.3290E-01 2.3726E-01 -2.8000E+00	5.7059E-01 1.2128E-01 -2.0000E+00	5.8333E-01 -2.5203E-08 -2.0000E+00	5.7059E-01 -1.2128E-01 -2.0000E+00	5.3290E-01 -2.3726E-01 -2.0000E+00	4.7193E-01 -3.4287E-01 -2.8000E+00	3.9033E-01 -4.335@E-01 -2.0000E+00	2.9167E-01 -5.0518E-01 -2.0000E+80	1.8026E-31 -5.5478E-01 -2.000E+00	5.0375E-02 -5.801%E-01 -2.0000E+00	7.8396E-12 7.4589E-01 -2.1000E+00	2.3176E-01 7.1329E-01 -2.0000E+00	3.7500E-01 6.4952E-01 -2.3000E+00	5.0185E-01 5.5736E-01 -2.0000E+00	5.1576E-01 4.4094E-01 -2.5000E+00	6.8516E-01 3.0505E-01 -2.0000E+00	7.3361E-01 1.5593E-01 -2.0000E+00	7.5000E-01 -3.2434E-08 -2.0000E+00	7.3361E-01 -1.5593E-01 -2.0000E+00
:	•	?	1.	3.5	5.3	:	3.5	9	11	9.0	6.6	•	15	3.5		:	5.5	9	2.5		6.6

-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+80	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0080E+80	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	E-01 0.
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:		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	•	
2.6180E-02	2.6180E-02	2.6180E-02	2.61806-02	2.6180E-02	2.6100E-02	3.1998E-02	3 -1 998 E-02	3.19986-02	3.19986-02	3.19986-02	3.1998E-02	3.1998E-02	3.19986-02	3.19986-02	3.19986-82	3.1998E-02	3.1998E-02	3.1998E-02	3.199&E-02	3.1998E-02	3.49076-02
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6.8516E-01 -3.8505E-01 -2.8080E+80	6.0476F-01 -4.\$00\$E-01 -2.0000E+00	c ata56-81 -5.5736E-01 -2.0800E+80	3.7580E-01 -6.4952E-01 -2.8880E+80	2.3176E-01 -7.1329E-01 -2.0000E+00	7.83965-02 -7.45895-01 -2.00805+80	9,5818E-12 9.1165E-01 -2.6080E+00	2.832 7E-81 8.7180E-01 -2.8080E+80	4.5833E-01 7.9386E-01 -2.0000E+00	6.1337E-01 6.8122E-01 -2.0000E+00	7.4160E-01 5.3880E-01 -2.0000E+00	8.3742E-01 3.7284E-01 -2.8080E+80	8.9664E-91 1.9059E-01 -2.0080E+80	9.1667E-01 -3.3605E-08 -2.8000E+80	8.96645-01 -1.90595-01 -2.0000£+00	8.3742E-01 -3.7284E-01 -2.0000E+00	7.4160E-01 -5.3080E-01 -2.0000E+80	6.1337E-01 -6.9122E-01 -2.0000E+00	4.5833E-01 -7.9386E-01 -2.0000E+00	2.8327E-01 -8.7188E-01 -2.3000E+00	9.56186-02 -9.11656-01 -2.00006+00	. 44615-01 9.94525-01 -1.91575+00
:		: :	2 5	: :	: 2	. 2	:		5	:	=	~	=	: :		.0				96	•

24	3.0982E-81	9.5106E-01 -1.9167E+00	000	2.000E+00	3.4907E-02	3.0902E-01	9.51066-01	:
7	5.0000E-01	0.6603E-01 -1.9167E+00	00+3	2.3803E+00	3.4907E-02	5.0000E-01	8.6603E-01	•
*	6.6313E-01	7.6316E-01 -1.9167E+00	E+00	2.000E+00	3.49076-02	6.6913E-01	7.4314E-01	;
\$	8.0902E-01	5.6779E-01 -1.9157E+80	00.3	2.000E+00	3.4907E-02	8.0902E-01	5.87796-81	:
*	9.13556-01	4.8674E-01 -1.9167E+80	E • 0 0	2.3800 E+00	3.4907E-02	9.13556-01	4.0674E-01	:
*	9.7815E-01	2.8731E-01 -1.9157E+00	00+3	2.3800E+00	3.4907E-02	9.7815E-01	2.0791E-01	:
	1.0000E+00	-4.3285E-08 -1.9167E+00		2.3800E+00	3.49076-02	1.0000E+00	1.0000E+00 -4.3205E-08	:
66	9.7815E-81	-2.8731E-01 -1.9167E+00	000	2.0000E+00	3.4907E-02	9.7815E-01	9.7815E-01 -2.0791E-01	
:	9.1355E-81	-4.8674E-01 -1.9157E+00	00+	2.3 000E.00	3.49076-02	9.1355E-01	9.1355E-01 -4.0674E-01	:
=	8.0302E-01	-5.8779E-01 -1.9157E+80	•	2.000E+80	3.49875-02	8.0902E-01	-5.8779E-01	;
281	6.6913E-01	-7.4314E-01 -1.9157E+00	000	2.3800E+00	3.4907E-02	6.6913E-01	6.6913E-01 -7.4314E-01	:
	5.0000E-01	-8.6683E-81 -1.9167E+88	•	2.1000E+00	3.4907E-02	5.0000E-01	5.0000E-01 -8.6603E-01	:
*	3.0902E-01	-9.5106E-01 -1.9167E+00	00+	2.1000E+00	3.4907E-02	3.0902E-01	-9.5106E-01	:
119	1.0453E-01	-9.9452E-01 -1.9167E+00	00.	2. 0 000 E+00	3.4907E-02	1.0453E-01	-9.9452E-01	:
91	1.0453E-01	9.94526-01 -1.75306+00	00+	2.3 000E+00	3.4907E-02	1.0453E-01	9.94526-01	:
111	3.0902E-01	9.5186E-01 -1.7500E+00		2.0000E+00	3.4907E-02	3.09026-01	9.5106E-01	:
:	5.0000E-01	8.6603E-81 -1.7580E+80		2.3800E+00	3.49076-02	5.00006-01	8.6683E-01	
119	6.6913E-01	7.4316E-01 -1.7500E+00		2.3000E+00	3.4907E-02	6.6913E-01	7.43146-01	:
• 11	8.0902E-01	5.8779E-01 -1.7580E+00		2.0000E+00	3.4907E-02	8.0902E-01	5.87796-01	:
111	9.1355E-01	4.8674E-01 -1.7588E+80	:	2.0000E+00	3.4907E-02	9.13556-01	4.0674E-01	:
211	9.7815E-01	2.0791E-01 -1.7500E+00	00+	2.0000E+00	3.49076-02	9.7815E-01	2.0791E-01	
113	1.0080E+00/	1.0080E+00/-4.3285E-08 -1.7500E+00	00.	2.000E+00	3.4907E-02	1.0000E+00 -4.3205E-08	4.3205E-08	

2 9.7815E-01 -2.0791E-01 0.	2 9.1355E-01 -4.0674E-01 0.	2 6.0902E-01 -5.8779E-01 0.	6.6913E-01 -7.4314E-01 0.	5.0000E-01 -0.6683E-01 0.	3.0902E-01 -9.5106E-01 0.	1.0453E-01 -9.9452E-01 0.	1.0453E-01 9.9452E-01 0.	3.0902E-01 9.5106E-01 0.	5.0000E-01 6.6693E-01 0.	6.6913E-01 7.4314E-01 0.	8.0902E-01 5.6779E-01 0.	9.1355E-81 4.0674E-01 0.	9.7815E-01 2.0791E-01 0.	1.8800E+80 -4.3285E-86 8.	9.7815E-81 -2.8791E-81 8.	9.1355E-81 -4.8674E-81 8.	8.0902E-01 -5.6779E-01 0.	6.69134-81 -7.43146-81 8.	5.0000E-01 -0.66#3E-01 0.	3.0902E-01 -9.5106E-01 0.	0 10 10 10 10 10 10 10 10 10 10 10 10 10
3.19076-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4987E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4987E-02	3.4907E-82	3.4987E-02	3.4907E-02	3.4987E-02	3.4987E-02	3.4907E-02	3.4907E-02	3.4987E-02	3.4907E-02	3.4987E-02
2.000E+00	2.000E+00	2.0000E+00	2.0800E+00	2.0800E+00	2.3803E+80	2.000E+00	2.0000E+00	2.000E+00	2.0980E+00	2.3880E+88	2.3000E+00	2.0800E+00	2.3000E+00	2.0000E+00	2.3800E+00	2.8800E+00	2.3000E+00	2.3000E+00	2.3800E+00	2.3888E+88	2.3880E+88
9.7815E-01 -2.0731E-01 -1.7500E+00	9.1355E-01 -4.1674E-01 -1.7503E+80	8.0302E-01 -5.8779E-01 -1.7300E+00	6.6313E-01 -7.4314E-01 -1.7500E+00	-8.5603E-01 -1.7580E+00	3.0902E-81 -9.5136E-01 -1.7500E+80	1.0453E-01 -9.9452E-01 -1.7500E+00	9.3452E-01 -1.5833E+00	9.5186E-01 -1.5833E+00	8.5683E-01 -1.5833E+80	7.43146-01 -1.58336+80	5.8779E-01 -1.5833E+00	4.0674E-01 -1.583E+80	2.8791E-01 -1.5833E+00	-4.3285E-08 -1.5833E+88	9.7815E-01 -2.0731E-01 -1.5833E+80	-4.8574E-01 -1.5833E+00	8.0382E-81 -5.8779E-01 -1.5833E+80	-7.4314E-01 -1.5033E+00	5.0000E-01 -8.6683E-01 -1.5833E+80	3.0902E-01 -9.5186E-01 -1.5833E+00	1.0453E-81 -9.9452E-01 -1.5833E+00
9.7815E-01	9.13556-01	8.0302E-01	6.6313E-01	5.0000E-01	3.0382E-81	1.0453E-01	1.0453E-01	3.0302E-01	5.0000E-01	6.6313E-81	8.0902E-81	9.1355E-01	9.7815E-01	1.0000E+00 -	9.7815E-01 -	9.13556-01 -	8.0902E-01 -	6.6913E-11	5.0000E-01 -	3.09025-01 -	1.0453E-81 -
1	115	:	111	111	611	120	121	122	123	121	125	126	127	128	621	130	131	132	133	134	135

																	:				
9.9452E-01 0.	9.5186E-81 8.	6.6683E-81 0.	7.4314E-01 0.	5.87796-01 0.	4.0674E-01 0.	2.0791E-01 0.	-4.3285E-08 0.	.2.0791E-01 0.	4.8674E-81 8.	.5.8779E-01 6.	7.4314E-01 0.		.9.5186E-01 0.	-9.9452E-01 0.	9.9452E-01 0	9.5106E-01 0	8.6683E-01 0	7.4314E-01 0	S.8779E-01 0	4.0674E-01 0	2.07916-01 0
1.04536-01	3.0902E-01	5.0000E-01	6.6913E-01	8.0902E-01	9.1355E-01	9.7815E-01	1.0000E+60	9.78156-61 -2.87916-81	9.13556-01 -4.06746-01	8.0902E-81 -5.8779E-01	6.6913E-01 -7.4314E-01	5.0000E-01 -8.6683E-01	3.8982E-81 -9.5186E-81	1.0453E-01	1.0453E-01	3.0902E-01	5.0000E-01	6.6913E-01	8.0902E-01	9.13556-01	9.78156-01
3.4907E-02	3.49876-02	3 907E-02	3.*907E-02	3.4987E-02	3.4907E-02	3. 4907E-02	3.4987E-02	3.4987E-02	3.49076-62	3.4907E-02	3.4907E-02	3.4907E-02	3.4987E-02	3.4907E-02	3.49076-02	3.4907E-02	3.4907E-02	3.49876-02	3.49076-02	3.49076-02	3.49076-02
2.0003E+00	2.3803£+00	2.3880E+00	2.3800E+00	2.3000E+00	2.3000E+00	2.000E+00	2.0000E+00	2.8860E+80	2.0000E+00	2. 3 880 E + 0 8	2.1800E+00	2.0000E+00	2.3000E+00	2.0000E+00	2.0000E+00	2.0800E+00	2.1990E+00	2.0800E+00	2.3000E+00	2.0000E+00	2.0000E+00
9.9452E-01 -1.4167E+00	-01 -1.157E+00	:-01 -1.4157E+00	:-01 -1.4157E+00	E-01 -1.4157E+00	E-01 -1. 1167E+00	E-01 -1.4167E+08	E-08 -1.4167E+04	E-01 -1.4157E+80	E-01 -1.4167E+00	-5.8779E-01 -1.4167E+00	-7.6316E-01 -1.0157E+00	-8.6603E-01 -1.4167E+80	-9.5186E-01 -1.4167E+00	1.0453E-01 -9.9452E-01 -1.6157E+00	9.9452E-01 -1.2580E+00	9.5106E-01 -1.2580E+00	8.5613E-01 -1.2500E+00	E-01 -1.2500E+00	E-01 -1.2510E+00	E-01 -1.2500E+00	2.0791E-01 -1.2500E+00
	1 9.51062-01	1 8.6683E-01	1 7.4314E-01	1 5.8779E-01	1 4.3674E-01	1 2.07916-01	0 -4.3235E-08	1 -2.87916-01	1 -4.8674E-01					11 -9.9452				11 7.63166-01	11 5.8779E-01	11 4.0674E-01	
1.0453E-01	3.09026-01	5.0000E-01	6.6313E-01	8.0902E-01	1.13556-01	9.7815E-81	1.0000E+00	9.7815E-01	9.1355E-01	8.0382E-01	6.6913E-01	5.8080E-01	3.0302E-01	1.04536-0	1.8453E-81	3.0902E-01	5.0000E-01	6.6913E-01	8.0902E-31	9.13556-01	9.7815E-01
136	137	138	139	:	3	241	113	:	11.5	9.	1.1	•	119	150	151	132	153	5	155	136	137

158	1.0000E+00 -4.3205E-08 -1.2500E+00	2.0000E+00 3.	3.4907E-02	1.0000E+00 -4.3205E-08 0.	
139	9.7815E-01 -2.0791E-01 -1.2500E+00	2.3000E+00 3.	3.4907E-02	9.7815E-01 -2.0791E-01 0.	
160	9.13556-01 -4.06746-01 -1.25006+00	2.0800E+00 3.	3.4907E-02	9.1355E-01 -4.0674E-01 0.	
191	8.0902E-01 -5.0779E-01 -1.2500E+00	2.3800E+00 3.	3.4907E-02	8.0902E-01 -5.8779E-01 0.	
162	6.6913E-01 -7.4314E-01 -1.2500E+00	2.3800E+00 3.	3.4987E-02	6.6913E-01 -7.4314E-01 0.	
163	5.0000E-01 -8.6603E-01 -1.2500E+00	2.3000E+00 3.	3.4907E-02	5.0000E-01 -8.6603E-01 0.	
151	3.0902E-01 -9.5106E-01 -1.2500E+00	2.000E+00 3.	3.4907E-02	3.0902E-01 -9.5106E-01 0.	
155	1.04536-01 -9.34526-01 -1.25806+00	2.0800E+00 3.	3907E-02	1.0453E-01 -9.9452E-01 0.	
;	1.0453E-01 9.9452E-01 -1.1033E+00	2.3000E+00 3.	3.4907E-02	1.0453E-01 9.9452E-01 0.	
157	3.0902E-01 9.5106E-01 -1.0833E+80	2.0000E+00 3.	3.4907E-02	3.0902E-01 9.5106E-01 0.	
158	5.0000E-01 8.6683E-01 -1.1833E+00	2.3800E+00 3.	3.4907E-02	5.0000E-01 8.6603E-01 0.	
159	6.6313E-01 7.4314E-01 -1.0833E+00	2.3000E+00 3.	3.4907E-02	6.6913E-01 7.4314E-01 0.	
17.0	8.0302E-01 5.8779E-01 -1.3833E+00	2.3000E+00 3.	3.4907E-02	8.0902E-01 5.8779E-01 0.	
1/1	9.13556-01 4.86746-01 -1.88336+00	2.0000E+00 3.	3.49076-02	9.1355E-01 4.0674E-01 0.	
11.2	9.78156-01 2.87316-01 -1.88336+00	2.0000E+00 3.0	3.4907E-02	9.7815E-01 2.0791E-01 0.	
173	1.0000E+00 -4.3205E-08 -1.0833E+00	2.0000E+00 3.0	3.4907E-02	1.0000E+00 -4.3205E-08 0.	
5	9.7815E-01 -2.0731E-01 -1.0833E+00	2.0000E+00 3.	3.49076-02	9.7815E-01 -2.0791E-01 0.	
175	9.1355E-01 -4.0674E-01 -1.0833E+00	2.0000E+00 3.0	3.49076-02	9.1355E-01 -4.0674E-01 0.	
176	8.0302E-01 -5.8779E-01 -1.383E+00	2.3800E+00 3.4	3.49076-02	8.0902E-01 -5.8779E-01 0.	
111	6.6913E-01 -7.4314E-01 -1.0833E+00	2.0000E+00 3.4	3.4907E-02	6.6913E-01 -7.4314E-01 0.	
178	5.0000E-01 -8.6603E-01 -1.;533E+00	2.3000E+00 3.4	3.49076-02	5.0000E-01 -8.6603E-01 0.	
17.9	3.0302E-11 -9.5106E-01 -1.0833E+00	2.0000E+00 3.4	3.4907E-02	3.0902t-01 -9.5106E-01 0.	

	1.04536-01	-9.3452E-01	1.0453E-01 -9.9452E-01 -1.0833E+00	2.1800E+00	3.4907E-02	1.0453E-81 -9.9452E-01	-9.9452E-01	
-:	1.04536-01		9.9452E-01 -9.1667E-01	2.3000E+00	3.49076-02	1.04536-01	9.94526-01	:
m.	3.09026-01	9.5136E-01	-9.1657E-01	2.0000E+00	3.4907E-02	3.0902E-01	9.51066-01	:
10	5.0000E-01	8.66035-01	-9.1567E-01	2.3003E+00	3.4907E-02	5.0000E-01	8.6603E-01	
.0	6.6913E-81	7.43146-01	-3.1657E-01	2.3003E+00	3.4907E-02	6.6913E-01	7.4314E-01	:
•	8.0302E-01	5.87796-01	1 -9.1667E-01	2.000E+00	3.4907E-02	8.0902E-01	5.87796-01	:
•	9.13556-11		4.0674E-01 -9.1657E-01	2.3000E+00	3.4907E-02	9.13556-01	4.0674E-01	
OT.	9.7815E-01	2.07316-01	1 -9.1667E-01	2.000E+00	3.4907E-02	9.7815E-01	2.07916-01	:
•	. 0000E+00	1.0000E+00 -4.3205E-08	1-3.1657E-01	2.9 B00E+00	3.4907E-02	1.0000E+00	1.0000E+00 -4.3205E-08	
	9.7915E-01	1 -2.0791E-01	1 -9.1667E-01	2.3003E+00	3.4907E-02	9.7815E-01	9.7815E-01 -2.0791E-01	:
	9.1355E-01	-4.8674E-01	-4.0674E-01 -9.1567E-01	2.0000E+00	3.49076-02	9.1355E-01	9.1355E-01 -4.0674E-01	:
-	8.8302E-01	-5.8779E-01	1 -9.1667E-01	2.3800E+00	3.4907E-02	8.0902E-01	8.0902E-01 -5.8779E-01	:
	6.6913E-01	1 -7.43146-01	1 -3.1657E-01	2.0000E+00	3.49076-02	6.6913E-01	6.6913E-01 -7.4314E-01	
	5.0000E-01	1 -8.6633E-01	1 -9.1657E-01	2.0000E+00	3.49076-02	5.0000E-01	5.0000E-01 -6.6603E-01	
-	3.0902E-01	1 -9.5186E-01	1 -9.1657E-01	2.0000E+00	3.4907E-02	3.8902E-01	-9.51 B6E-01	:
-	1.0453E-01	1 -9.9452E-01	1 -9.1667E-01	2.3000E+00	3.4907E-02	1.0453E-01	1.0453E-01 -9.9452E-01	:
-	1.0453E-01	1 9.9452E-01	1 -7.50006-01	2.9 000 E+00	3.49076-02	1.0453E-01	9.94526-01	
	3.0902E-01		9.5106E-01 -7.5000E-01	2.1000E+00	3.4907E-02	3.0902E-01	9.5106E-01	:
u.	5.00006-91	1 8.6683E-01	1 -7.5000E-01	2.000E+00	3.4907E-02	5.0000E-01	0.6603E-01	:
-	6.6913E-01		7.4314E-01 -7.5000E-01	2.0000E+00	3.49076-02	6.69136-01	7.4314E-01	:
_	8.0902E-01	1 5.87796-01	1 -7.50006-01	2.0000E+00	3.4907E-02	8.0902E-01	5.8779E-01	:
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9.78156-01 2.07916-01 0	1.0000E+00 -4.3205E-08 0	9.7815E-01 -2.0791E-01 0	9.13556-01 -4.06746-01 0	8.0902E-01 -5.8779E-01 0	6.6913E-01 -7.4314E-01 0	5.0000E-01 -6.6603E-01 0	3.0902E-01 -9.5106E-01 0	1.0453E-01 -9.9452E-01 8	1.04536-01 9.94526-01 0	3.0902E-01 9.5186E-01 0	5.0808E-01 8.6683E-01 8	6.69136-01 7.43146-01 0	8.0902E-01 5.8779E-01 8	9.1355E-01 4.8674E-01 0	9.7815E-81 2.8791E-81 8	1.0000E+00 -4.3205E-08 0	9.7815E-01 -2.0791E-01 0	9.1355E-01 -4.0674E-01 0	8.0902E-01 -5.8779E-01 0	6.6913E-01 -7.4314E-01 0	5.0000E-01 -6.6603E-01 0
3.4907E-02	3.4907E-02	3.+967E-02	3.4907E-02	3.4907E-02	3.49076-02	3.49076-02	3.49076-02	3.4907E-02	3.4907E-02	3.49076-02	3.4907E-02	3.49076-02	3.49076-02	3.4907E-02	3.49076-02	3.4907E-02	3.49076-02	3.49076-02	3.49076-02	3.49076-02	3.4907E-02
2.0000E+00	2.000E+00	2.0000E+00	2.3000E+00	2.3800E+00	2.3800E+80	2.1000E+00	2.000E+00	2.0000E+00	2.3800E+80	2.3000E+00	2.3800E+00	2.3 830E+60	2.3800E+00	2.0000E+00	2.0000E+00	2.0000E+00	2.0800E+00	2.0000E+00	2.3000£+00	2.0800E+00	2.3800E+00
2.0731E-01 -7.5030E-01	1.0000E+00 -4.3205E-08 -7.3000E-01	9.7815E-01 -2.0731E-01 -7.5030E-01	9.1355E-01 -4.0674E-01 -7.5000E-01	8.0302E-11 -5.8779E-01 -7.5000E-81	6.6913E-01 -7.4314E-01 -7.5000E-01	5.0000E-01 -8.6603E-01 -7.5000E-01	3.0902E-01 -9.5106E-01 -7.5000E-01	1.0453E-01 -9.9452E-01 -7.5000E-01	9.9452E-01 -5.833E-01	9.5106E-01 -5.833E-01	8.6683E-01 -5.833E-01	7.43146-01 -5.93336-01	5.87796-01 -5.83336-01	4.0674E-01 -5.833E-01	2.07316-01 -5.8338-01	1.0000E+00 -4.3205E-08 -5.8333E-01	9.7015E-01 -2.0731E-01 -5.5333E-01	9.13556-01 -4.06746-01 -5.83336-01	8.0382E-01 -5.8779E-01 -5.833E-01	5.6315E-01 -7.4314E-01 -5.8333E-01	5.0000E-01 -8.6603E-01 -5.933E-01
9.7315E-01	1.0000E+00	9.7815E-01	9.13556-01	8.03026-01	6.6913E-01	5.0000E-01	3.09026-01	1.04536-01	1.0453E-01	3.09026-01	5.0000E-01	6.6913E-01	8.0302E-01	9.13552-01	9.7815E-01	1.0000E+00	9.7815E-01	9.13556-01	8.0382E-01	5.6913E-01	5.0000E-01
202	203	:	502	513	23.7	238	682	510	1112	212	213	\$12	515	912	217	\$12	513	220	122	222	223

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3.0902E-01 -9.5106E-01	1.04536-01 -9.94526-01	9.94526-01	9.5106E-01	6.6663E-01	7.43146-91	5.6779E-01	4.06746-01	2.07916-01	-4.3205E-08	-2.07916-01	-4.0674E-01	-5.6779E-01	6.69136-01 -7.43146-01	-0.66035-01	3.0902E-01 -9.5106E-01	-9.9452E-81	9.9452E-01	9.51066-01	8.6683E-01	7.43146-01	5.87796-01	
		1.04536-01	3.09026-01	5.00006-01	6.6913E-01	6.0982E-01	9.13556-01	9.78156-01	1.0000E+00	9.78156-01	9.13556-01	6.0902E-01	6.69136-01	5.0000E-01	3.0902E-01	1.04536-01	1.04536-01	3.0902E-01	5.0000E-01	6.6913E-01	8.0902E-01	
3.4907E-02	3.4907E-62	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.49076-02	3.49076-02	3.4907E-02	3.49076-02	3.4907E-02	3.4907E-02	3.49076-02	3.49076-02	3.49876-02	3.49076-02	3.49076-02	3.4907E-02	3.49076-02	3.49076-02	3.49076-02	
2.3800E+00	2.3883E+00	2.0000E+00	2.0003E+00	2.3880E+80	2.3800 E+00	2.3800E+00	2.3830E+00	2.000E+00	2.0000E+00	2.38035+00	2.0000000	2.3000E+00	2.0000E+00	2.3 000E+00	2.8880E+00	2.3800E+00	2.0000E+00	2.3000E+00	2.0000E+00	2.3803E+00	2.0800E+00	
-9.5106E-01 -5.8333E-01	1 -5. 53336-61	1 -4.1657E-01	9.5106E-01 -4.1657E-01	1 -4.1667E-01	7.4314E-31 -4.1667E-01	5.8779E-01 -4.1667E-01	4.0674E-01 -4.1567E-01	2.0731E-01 -4.1667E-01	1.00002+00 -4.3205E-08 -4.1557E-01	9.7015E-01 -2.0731E-01 -4.1667E-01	-4.0674E-01 -4.1557E-01	8.0382E-01 -5.8779E-01 -4.1657E-01	5.6913E-91 -7.4314E-01 -4.1667E-01	1 -4.1657E-01	1 -4.1557E-01	-9.9472E-01 -4.1657E-01	1 -2.5000E-01	-2.5000E-01	-2.5888E-01	-2.5080E-01	5.8779E-01 -2.5080E-01	
	1 -9.34526-01	1 9.9452E-01		1 8.56035-01					-4.3205E-0	-2.87316-0	-4.0674E-0	-5.8779E-0	-7.4314E-0	-8.6603E-01	-9.51066-01		9.34526-01	9.5106E-01	8.66938-01	7.4314E-01		
3.0902E-01	1.04536-01	1.0453E-01	3.0902E-11	5.0000E-01	6.6913E-01	8.0302E-01	9.13556-01	9.7815E-01	1.00005+00	9.78156-01	9.1355E-01	8.0382E-01	6.6913E-81	3.0000E-01	3.0902E-01	1.0453E-01	1.04536-01	3.09026-01	5.0000E-01	6.6313E-01	8.0982E-01	
*22	522	922	222	528	623	230	231	232	233	134	535	536	237	23.8	233	240	2.1	242	243	:	542	

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4.06746-01	2.0791E-01	1.0000E+00 -4.3205E-08	9.7815E-01 -2.0791E-01	-4.06746-01	8.09026-01 -5.87796-01	6.69136-01 -7.43146-01	-8.6603E-01	-9.51 06E-01	1.0453E-01 -9.9452E-01	9.9452E-01	9.5106E-01	0.6603E-01	7.43146-01	5.67794-01	4.0674E-01	2.0791E-01	1.0000E+00 -4.3205E-08	-2.67916-61	-4.06746-01	-5.8779E-01	6.6913E-01 -7.4314E-01
		- 00+3I	E-01 -2		6-01 -5	£-01 -7	£-01 -8	E-01 -9	E-01 -9								- 00 ·	2- 10-3	- 10-		-01 -7.
9.13556-01	9.78156-01	1.000	9.7819	9.13556-01	8.0902	6.6913	5.00006-01	3.0902E-01	1.0453	1.04536-01	3.0902E-01	5.0000E-01	6.6913E-01	8.0902E-01	9.13556-01	9.7815E-01	1.0000	9.7815E-01	9.1355E-01	8.0902E-01	6.6913
3.4907E-02	3.49076-02	.49076-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.49076-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.4907E-02	3.49076-02	3.49076-02	3.4907E-02	3.49076-02	3.49076-02	3.49076-02	3.49076-02
3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.496	3.490	3.490	3.490	3.490
E+00	E+00	E+00	E+00	E+00	E+00	E+00	E +00	E + 0.0	E + 0 0	E + 00	E • 0 0	E • 00	E+00	E • 00	00+3	00+3	000	000	000	000	000
2.3803E+00	2.0000E+00	2.3000E+00	2.3.00E+00	2.00006+00	2.0800€+00	2.3000E+00	2.3803E+00	2.0000E+00	2.0000E+00	2.30006+00	2.0000E+00	2.0000E+00	2.3000E+00	2.0000E+00	2.0000€+00	2.00006+00	2.3000E+00	2.0000E+00	2.0000E+00	2.0000E+00	2.3000E+00
-01	-01	-01	-01	- 01	-01	-01	-01	-01	÷	-05	-05	-05	-05	- 0.5	-05	-05	20.	20.	.02	20	95
4.0674E-01 -2.5000E-01	2.0791E-01 -2.5000E-01	-2.5000E-01	-2.0731E-01 -2.5000E-01	.2.5000E	-2.5000E-01	-7.4314E-01 -2.3000E-01	-8.6603E-01 -2.5000E-01	-2.50006-01	-2.5000E-01	-8.3335-02	-9.333E-02	-8.3336-02	-8.333E-02	5.8779E-01 -8.3333E-02	-9.53336-02	-8.333E-02	-4.3235E-00 -8.333E-02	-8.3338-02	-8.333E-02	-9.33336-02	3. 5333E-
746-01	91E-01	-4.3235E-08	10-316	74E-01	-5.87795-01	1 4E - 01 .	03E-01 -	-9.5106E-01 -	-9.9452E-01 -	9.3452E-01 -	9.5186E-01 -	6.6603E-01 -	7.4314E-01 -	- 10-36	4.0674E-01 -	2.0731E-01 -	SE-08 -			- 10-36	- 10-34
			1 -2.07	-4.08		-7.43											-4.323	-2.073	-4.0674E-01	-5.8779E-01	-7.431
9.1355E-01	9.7815E-01	1.0000E+03	9.7815E-01	9.1355E-01 -4.0674E-01 -2.5000E-01	8.0302E-01	6.6913E-01	5.0000E-01	3.03026-01	1.04536-01	1.04536-01	3.0302E-01	3.0000E-01	6.69135-01	8.0902E-01	3.13556-01	9.7815E-01	1.0000E+00	9.7815E-11 -2.0791E-01	9.1355E-01	8.03026-31	5.5913E-01 -7.4314E-01 -8.533E-02
5 942	6 242	248	6 642	6 052	251 8	352 6															
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-0.6603E-01	-9.5106E-01	-9 94 525-01
5.0000E-01	3.09026-01	1.04536-01
3.1907E-02 5.0000E-01 -0.6603E-01 0.	3.4907E-02 3.0902E-01 -9.5106E-01 0.	0 10-35-30 0- 10-35-01 1 0-36-01
2.3 000E+00	2.000E+00	O 270 1.0453E-01 -9.9452E-01 -8.3333E-02 2.3800E+00
258 5.0080E-01 -8.6683E-01 -8.3333E-02 2.3800E+00	253 5.0302E-81 -9.5106E-01 -0.5333E-02 2.8800E+00	-8.3333F-02
-0.6603E-01	-9.5106E-01	-9.9452E-01
5.0000E-01	3.0302E-01	1.0453E-01
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SJAFASE NORMAL VELOSITY BOUNDARY SONSITION

SJRFACE JELOCITIES! REAL PART, IMAGINARY PART

	;	•	8 7	•	VI 123	•	V( 16)	•	V. 201		11 24)	•	V. 281	•	V( 32)	•	V( 36)		104 34	•	** **	•	164 17	•	V( 52)	•
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	46 33	••		•	VC 113	•	V( 15)	•	VC 191	•	V( 23)	•	46 27)	;	V ( 31)	.0	46 351	•	V( 39)	•	46 43)	.0	125 37	.0	41 51)	.0
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165 14	•	165 11	•	V( 63)	•	V. 671	•	VC 713	:	V ( 75)	•	162 34	:	V. 63)	:	VC 871	•		
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RESTON = 2

4.8914E-01 3.2594E-01 5.4721E-01 5.0202E-01

V (105)

V(102)

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116 14

V ( 93)

-5.5240E-01 7.7419E-01 -5.6106E-81 6.5970E-01 -5.4721E-01 5.0282E-01 -4.8914E-01 3.2594E-01

V(109)

4 (108)

4 (107)

V(110)

-3.7355E-11 1.5191E-01 -2.0345:-11 4.2916:-02 4.3205E-08 1.8667E-15 2.0343E-01 4.2917E-02

V(113)

4(112)

462793	4 (180)	V (181)	V(1.62)
5.52402-01 7.7419E-01	5.4192E-01 0.3391E-01	-5.4192E-01 0.3391E-01	-5.5240E-01 7.7419E-01
1(103)	(481)	V (185)	V(186)
-5.5106E-01 6.5370E-01	-5.4721E-01 5.0202:-01	-4.8914E-01 3.2594E-01	-3.7355E-01 1.6091E-01
(41187)	V(188)	V (189)	V (196)
-2.0343E-31 4.2315E-02	4.3205:-08 1.8667:-15	2.0343E-01 4.2917E-02	3.7355E-01 1.6091E-01
(161))	4(192)	V (193)	V(194)
4.8914E-31 3.2594E-01	5.4721E-01 5.0202:-01	5.6106E-01 6.5970E-01	5.52406-01 7.74196-01
1(195)	(1196)	V(197)	V(196)
5.41922-11 8.33912-01	-5.41925-01 6.3391:-01	-5.5240E-01 7.7419E-01	-5.6106E-01 6.5970E-01
1661))	W(200)	V (201)	V (202)
-5.4721E-01 5.0282E-01	-4.8914E-81 3.2594:-01	-3.7355E-01 1.6091E-01	-2.0343E-01 4.2916E-02
1(583)	4(204)	V (205)	V (206)
4.3205E-08 1.8567E-15	2.03432-01 4.29172-02	3.7355E-01 1.6091E-01	4.8914E-01 3.2594E-01
442071	4(208)	V (209)	V(210)
5.4721E-11 5.0282E-01	3.6106E-01 6.5970E-01	5.5240E-01 7.7419E-01	5.4192E-01 0.3391E-01
(112) V	4(212)	V (213)	V (214)
-5.4192E-01 6.3391E-01	-5.5240E-01 7.7419E-01	-5.6106E-01 6.5970E-01	-5.4721E-01 5.0282E-01
1(215)	V(216)	V (217)	V (218)
-4.8914E-01 3.2594E-01	-3.7355E-B1 1.6091:-01	-2.0343E-01 4.2916E-02	4.3205E-08 1.8667E-15
1 (219)	1 (220)	V (221)	V (222)
2.03435-01 4.29175-02	3.73556-01 1.60912-01	4.8914E-01 3.2594E-01	5.4721E-01 5.0282E-01
((523)	¥ (22+)	V (225)	V (226)
5.61862-01 6.5970E-01	5.5240E-81 7.7419E-01	5.4192E-01 8.3391E-01	-5.4192E-01 6.3391E-01
V (227)	4 (228)	V (229)	V(230)
-5.52402-01 7.74196-01	-5.61062-81 6.59702-01	-5.4721E-01 5.0282E-01	-4.8914E-01 3.2594E-01
V (231)	1(232)	V (233)	V (234)
-3.7355E-01 1.5091E-01	-2.0343E-01 4.2916:-02	4.3205E-08 1.8667E-15	2.03436-01 4.29176-02
1(235)	1(236)	V (237)	V (238)
3.7355E-01 1.5091E-01	4.8914E-81 3.2594:-01	5.4721E-01 5.0282E-01	5.6106E-01 6.5970E-01
1 (239)	¥(2+0)	V(241)	V (242)
5.5240E-11 7.7413E-01	5.4192E-81 6.3391:-01	-5.4192E-01 8.3391E-01	-5.5240E-01 7.7419E-01
1 (243)	¥1244)	V(245)	V(246)
-5.6106E-01 6.5970E-01	-5.4721E-01 5.0282E-01	-4.8914E-01 3.2594E-01	-3.7355E-01 1.6091E-01

116211	1.6091E-01	7	7.74196-01	•	6.5970E-01	121	4.2916E-02	3	4.8914E-01 3.2594E-01	101	5.4192E-01 6.3391E-01
6714	3.7355E-01 1.6091E-01	V(254)	5.5240E-01 7.7419E-01	V(258)	-5.6106E-01 6.5970E-01	V (262)	-2.0343E-01	V (266)	4.89146-01	V(270)	5.41926-01
v (249)	4.2917E-02	13)	5.6106E-01 6.5970E-01		7.7419E-01	111	1.6091E-01	159	3.7355E-01 1.6091E-01	(69)	5.5240E-01 7.7419E-01
4 ( S 4	2.0343E-01 4.2917E-02	V (253)	5.61066-01	V(257)	5.41922-01 8.33912-01 -5.4192:-81 8.33912-01 -5.5240E-01 7.7419E-01	V (261)	-5.47212-01 5.12822-11 -4.89142-01 3.25942-01 -3.7355E-01 1.6091E-01 -2.0343E-01 4.2916E-02	V (265)	3.73556-01	V (2691)	5.5240E-01
•	4.32052-08 1.86672-15	121	5.47212-81 5.02822-81	19:	8.3391 2-01	4(260)	3.2594 -01	**	2.0343:-81 4.2917:-02	4(258)	10-30163-91
1(548)	4.3205:-06	(1252)	5.47213-01	115561	-5.4192:-01	1231	-4.8914E-01	115641	2.0343:-01	16	3.61062-01
121	4.23165-02	511	4.89142-01 3.25946-01	155	8.33916-01	165	5.32825-31	631	4.32052-08 1.85672-15	4 (267)	5.47217-01 5.02827-01 5.61067-01 6.59707-01
4 (247)	-2.03435-01 4.29165-02	(1521)	10-24168.4	1(552) 1	5.41925-01	1652)1	-5.47215-01	11263)	4.3205:-08	100	5.47215-01

ENTER SUBROUTINE FOR ITERATIVE SOLUTION FOR SURFACE PRESSURE

REQUESTED LIMIT ON NUMBER OF ITERATIONS # 33

RELAKATION FACTOR SPECIFIED IS

REAL PART IMAGINARY PART 5.0000E-01 0. DOVERGENDE DRITERION = 1.0000E-04

BESTN ITERATION

TIME = 2.429E+02 SECONDS

44KIMUH DIFFERENCE BETHERN COMPONENTS
OF SUGJESSIV: VECTORS
1.1941E-00

1.67285-01

8.76025-02

4.1245E-02 1.8887E-02

9.84825-03

5.87235-03

2.42398-03

1.59195-03

1.05536-03

3.18735-04

2.15375-04

1.4579E-04 9.8818E-05 ITERATION TERMINATED BY CONVERGENCE CRITERION BEINS MET

A TIME AT TERMINATION IS 4.820E+32 SECONDS

SURFACE PRESSURES! REAL PART, IMAGINARY PART

RESION \* 1

) (	13	9 d	21	7 4	3)	) d	7
-1.3145E-01	1.02%3E-01	-1.30916-01	1.0224:-01	-1.29855-01	1.01895-01	-1.2831E-01	1.0137E-01
) (	5.1	),	19	d	7.3	ď	10
-1.26342-01	1.0073E-01	-1.24005-01	9.9986:-02	-1.21396-01	9.91816-02	-1.1861E-01	9.8351E-02
1.	16	à	10)	ď	111)	P ( 12)	12)
-1.1578:-01	9.7335:-02	-1.1303:-81	9.67683-02	-1.30406-01	9.60803-02	-1.08266-31	9.55006-02
) (	2 ( 13)	) (	3( 14)	9 4	P( 15)	P ( 16)	161
-1.0649E-01	9.50465-02	-1.0526:-01	9.4735 = -02	-1.0462E-01	9.4578E-02	-1.5325E-01	1.1262E-01
,	17.1	) (	2(18)	9 4	P( 19)	P.C 201	201
-1.51945-11	1.12035-01	-1.49316-01	1.10795-01	-1.45376-01	1.0905E-01	-1.4017E-01	1.06886-01
),	112 16	ď	P ( 22)	ď	P( 23)	P( 24)	142
-1.3378E-01	1.3441E-01	-1.26366-11	1.01785-01	-1.1815E-01	9.9127E-02	-1.09496-01	9.65946-02
,	152	•	196)	9 4	P. C. 27.1	P. ( 28)	281
-1.00785-01	9.4298E-02	-9.2483E-02	9.2326:-02	-8.5092E-02	9.07326-02	-7.9068E-02	8.9540E-02
36	162	•	P ( 30)	3	P( 31)	P ( 32)	121
-7.4809E-02	8.87538-02	-7.2602:-12	8.8363:-02	-1.6985E-01	1.25135-01	-1.6817E-01	1.2498E-01
,	331	34	34)	P ( 35)	351	P ( 36)	191
-1.64735-01	1.22725-01	-1.59372-01	1.1947:-01	-1.5195E-01	1.15396-01	-1.4237E-01	1.1073E-01
, ,	( 37)	0 38) d	38)	P ( 39)	391	, ) d	10,
-1.3071E-01	1.05755-01	-1.17222-01 1.0003:-01	1.0083:-01	-1.0242E-01	9.62246-02	-8.7042E-02	9.2204E-02
),	2( 41)	6( 45)	,21	à	P( 43)	d	7
-7.20132-02	8.9924 E-02	-5.8344:-82	8.6437:-02	-4.7033E-02	8.4704E-02	-3.8952E-02	8.3636E-02
3.	159	194 14	191	ď	(1)	* id	197
-3.47415-02	8.31325-02	-1.80572-81	1.44552-01	-1.7900E-01	1.42786-01	-1.7562E-01	1.39296-01
	164	(05 ) c	100	P ( 51)	511	P ( 5	521
-1.69955-01	1.3417:-01	-1.6147:-11	1.2763:-01	-1.4969E-01	1.20045-01	-1.34396-01	1.11906-01
3	531	(45)6	149	P ( 55 )	151	P 6 9	195
-1.1572E-01	1.03825-01	-3.43265-82	9.6392:-02	-7.1349E-02	9.01155-02	-4.8318E-02	8.5261E-02
) (	571	185 ) c	191	3	(65	9 ) d	603
-2.69875-02	8.13612-02	-9.11342-83	7.97332-02	3.7620E-03	7.85746-02	1.0501E-02	7.80856-02

3	1.56116-01	18	1.08695-01	12	7.57576-02	3	2.13186-01	•	1.7761E-01		9.8788E-02		6.2216E-02		
649 Jd	-1.7617E-01 1.5611E-01	P( 68)	-1.1341E-01 1.0889E-01	P. 121	1.1381E-02 7.5757E-02	P( 76)	-1.7493E-01 2.1318E-01	P( 80)	-1.7059E-01 1.7761E-01	P. 84.	-7.2067E-02 9.8788E-02	P. 683	1.0087E-01 6.2216E-02		
P ( 53)	-1.8067E-01 1.6360E-01	P ( 67)	-1.3726E-01 1.2172E-01	P( 71)	8.0345E-02	P.( 75)	6.6728E-02 7.1859E-02	167 ) q	1.92335-01	633	1.1798E-01	673	6.2818E-02 6.5287E-02		
9	-1.8067E-01	4	-1.3726E-01	ă	-1.9651E-02 0.0345E-02	ă	6.6728E-02	ă	-1.7566E-01 1.9233E-01	P.( 83)	-1.0963E-01 1.1796E-01	P ( 87)	6.2818E-02		
16 62)	-1.0287:-81 1.6857:-01	P( 66)	-1.5545:-01 1.3454:-01	26 701	-5.25962-82 8.74813-82	167.36	5.6721E-82 7.2194E-02	P.C. 783	-1.76632-81 2.03062-01	821	-1.3905:-01 1.3666:-01	198	1.8328:-82 7.1948:-02	196	1.4319:-81 6.1302:-82
1.	-1.0287:-01	ă	-1.5545=-11	,	-5.25962-12	`	5.67216-02	4	-1.7663:-11	16 82)	-1.39055-1-	(98 ) d	1. 8328 - 82	96 74	1.4319:-01
3 ( 61)	-1.83705-01 1.71835-01	Pt 651	-1.6815E-01 1.4627E-01	169 ) c	-8.4643E-82 9.7165E-02	26 73)	3.7665E-82 7.3271E-02	122 34	-1.7581E-01 2.1990E-01	2 ( 81)	-1.59835-01 1.59395-01	158 ) c	-2.8117E-82 6.3118E-02	168 )4	6.13356-02
3.0	-1.83705-01	ă	-1.6815E-01	,	-8.46435-82	•	3.76652-12	•	-1.7581E-01	) (	-1.59035-31	) (	-2.81175-82	•	1.2859E-01

我们是我们是我们是我们是我们的 多四人多四人

RESTON = 2

-1.08966-01 4.12296-01

-4.1518E-82 4.5234E-81 -5.5859E-82 4.4756E-81 -7.9482E-82 4.3553E-81

126 ) e

196 ) c

-1.3545E-01 3.7420E-01

156 14

P. 94.

P ( 93)

-1.0149E-01 1.7814E-01

-1.4692E-81 3.2003:-01 -1.3977E-01 2.5244E-01

P ( 98)

P( 97)

2.7416E-01 -2.4664E-02

1.6702E-01 1.5504E-03

6.00375-02 4.55142-02

-3.3078E-02 1.0625E-01

166 1

P(100)

P (101)

P(106)

P(102)

1.7833E-02 5.6113E-01

4.7304E-01 -3.9135E-02

4.3669E-81 -3.9363E-02

3.6782E-81 -3.5418E-82

>(103)

(401) <

P (105)

-1.1064E-01 4.6020E-01

-7.3351E-02 5.0923E-01

-3.30685-12 5.39275-01

-2.9006E-04 5.5489E-01

P(109)

P(110)

-3.9548E-03 1.1575k-01

-8.3812E-02 2.0837E-01

-1.2611E-31 3.0363:-01

-1.3228E-81 3.9860E-81

(111)

P (116)

P (113)

P (117)

P(114)

1.06892-81 3.7057E-02 2.3544E-81 -2.05482-02 3.6480E-01 -5.5579E-02 4.7817E-01 -7.2282E-02

5.61662-01 -7.7327E-02 7.61662-01 -7.7327E-02 7.1233 -8.25992-13 6.1827E-01	5.05775-81 -7.77415-02 P(124) -5.38276-82 5.82765-01	P(121) 4.9372E-02 6.4486E-01 P(125) -9.6026E-02 5.2568E-01	P(122) 2.8832E-02 6.3716E-01 P(126) -1.2071E-01 4.4549E-01
01 3.4588E-01	P(128) -6.7625E-02 2.3697E-01	P(1291 2.0918E-02 1.3100E-01 P(133)	P(130) 1.4403E-01 4.0525E-02 P(134)
2,36952-01 -2,54146-02	4.3094E-81 -6.8145E-02	5.5726E-01 -8.8848E-02 P(137)	6.5036E-01 -9.6080E-02
31 -9.73922-02	5.7735E-82 7.1438E-81	4.5822E-02 7.0529E-01 P(141)	6.3293E-03 6.8353E-01 P(142)
02 6.4346E-01	-6.6467E-82 : 6002E-01	-1.1198E-01 4.9176E-01 P(145)	-1.0400E-01 3.0300E-01 P(146)
32 2.5394E-01	4,2617E-02 1,4825E-01 P(148)	1.7519E-01 4.9094E-02 P(149)	3.2898E-01 -2.4931E-02 P(150)
4.8370E-31 -7.1900E-02	5.19542-81 -9.60922-02 2(152)	7.1971E-01 -1.0536E-01 P(153)	7,7268E-81 -1,8758E-81 P(154)
7.84835-02 7.7356E-01	5.5784E-82 7.6326E-81	1.4966E-02 7.3901E-01 P(157)	-3.4775E-02 6.9510E-01 P(156)
02 6.2647E-01	-1.0527E-81 5.3182E-01	-9.5318E-02 4.1579E-01 P(161)	-4.0238E-62 2.8986E-01 P(162)
10 - 3591E-01 0 (163)	2.01615-01 6.00172-02	3.6404E-01 -1.9605E-02 P(165)	5.2729E-81 -7.8844E-82 P(166)
6.70532-01 -9.7999E-02	7,76175-81 -1,09072-01	8.3205E-01 -1.1214E-01 P(169)	8.4528E-02 8.2416E-01 P(170)
5.13985-02 8.12796-01	1.9898=-12 7.8641=-11	-3.0436E-02 7.3929E-01	-7.5839E-02 6.6640E-01
2 (171) -1.0010E-01 5.5563E-01 2 (175)	-6.7912E-02 4.4476E-01	P(173) -2.9064E-02 3.1201E-01 P(177)	7.79396-02 1.8297E-81 P(178)
01 7.1737E-02	3.93672-01 -1.23802-02	5.6369E-01 -6.7120E-02 P(181)	7.1282E-01 -9.6768E-02 P(182)
8.2280E-01 -1.03%1E-01	8.8098E-01 -1.1322:-01	8.7623E-02 8.6699E-01	6.42786-02 8.54736-01
P(183) 2.2464 <u>g</u> -32 8.2556E-01	-2.7978E-02 7.7677E-01	P(185) -7.3029E-02 7.0040E-01	P(186) -9.6142E-02 5.9644E-01

-8.1758E-02 4.7000E-01	-1.9562:-82 3.3242:-81	P(189) 9.1871E-02 1.9871E-01	P(190) 2.4371E-01 0.3227E-02
1610	(192)	P (193)	P (194)
4.1847E-01 -4.5025E-03	5.9394:-81 -6.2096:-02	7.47786-01 -9.38106-02	8.61236-01 -1.07776-01
(561) c	P (196)	P (197)	P (198)
9.21242-01 -1.1222E-01	8.89102-02 9.02472-01	6.5480E-02 8.8947E-01	2.3617E-02 8.5984E-01
(661) c	> (200)	P (201)	P (202)
-2.6721E-02 8.0788E-01	-7.12275-82 7.28715-01	-9.3152E-02 6.2143E-01	-7.6768E-02 4.9134E-01
P (203)	s (204)	P (205)	P (206)
-1.1695E-12 3.4938E-01	1.03426-01 2.12595-01	2.5952E-01 9.3754E-02	4.3880E-01 3.1562E-03
1(207)	P (208)	P (209)	P (210)
5.1862E-01 -5.5723E-02	7.7621E-01 -9.0114E-02	8.9240E-01 -1.0516E-01	9.5387E-01 -1.1013E-01
, (211)	> (212)	P (213)	P(214)
8.91735-02 9.30766-01	6.57302-02 9.17202-01	2.3912E-02 8.8641E-01	-2.6192E-02 6.3275E-01
1(512)	2 (216)	P (217)	P (216)
-7.0116E-12 7.5140E-01	-3.09552-02 6.41562-01	-7.2867E-02 5.0865E-01	-5.4383E-03 3.6439E-01
1612) c	P (220)	P (221)	P (222)
1.12625-01 2.24186-01	2.72095-01 1.02775-01	4.5490E-01 9.9607E-03	6.3809E-01 -5.1694E-02
3 (223)	3 (224)	P (225)	P (226)
7.9858E-01 -8.5595E-02	9.16892-01 -1.02292-01	9.7948E-01 -1.0769E-01	8.8951E-02 9.5200E-01
1,122)	1922)	P (229)	P (230)
5.5528=-02 9.37998-01	2.38002-82 9.06332-01	-2.6057E-02 8.5142E-01	-6.9465E-02 7.6847E-01
1(231)	P (232)	P (233)	P(234)
-8.9417E-02 6.3673E-01	-6.9995E-02 5.2179E-01	-7.6750E-04 3.7541E-01	1.1950E-01 2.3316E-01
1(235)	9 (236)	P (237)	P (238)
2.8148E-01 1.3987E-01	4.6689E-81 1.5444E-02	6.52576-01 -4.75136-02	0.1517E-01 -0.3181E-02
1653)	P (240)	P (241)	P (242)
3.3503E-01 -9.3711E-02	9.9843E-81 -1.0542:-01	8.8614E-02 9.6615E-01	6.5217E-02 9.5185E-01
0 (243)	(544)	P (245)	P (246)
2.3573E-02 9.1963E-01	-2.6087E-02 8.6389E-01	-6.9117E-02 7.7989E-01	-8.8444E-82 6.6693E-81
(242) c	P (2 4 8)	P (249)	P (250)
-6.8107E-02 5.3062E-01	2.33496-83 3.8267:-01	1.2408E-01 2.3927E-01	2.8772E-01 1.1476E-01

	(152) 4	511	₹.	(252)	P (253)	33	P (254)	;
	4.7405E-01	4.7485E-01 1.3275E-02	6.6216E-01	6.62166-01 -4.4536:-02	8.26156-01	8.2615E-01 -8.0841E-02	9.4703E-01 -9.7790E-02	-9.7790E-02
	P (2	15521	2).	(952)	P (257)	123	P (258)	
	1.01105+00	1.0110E+00 -1.337GE-01	8.8387E-02	9.73225-01	6.5008E-02	9.58785-01	2.34126-02	9.2628E-01
	2) (	(652)	2) 4	P (260)	P (261)	110	P (262)	121
	-2.6140E-82	-2.6140E-82 8.7813E-81	-6. 8971E-82	-6.8971E-82 7.8560:-81	-8.7976E-02 6.7204E-01	6.7204E-01	-6.7174£-02 5.3506E-01	5.3506E-01
	200	1(563)	2),	,(564)	P (265)	151	P (266)	191
	3.87985-83	3.8798E-03 3.9563E-01	1.26376-01	1.26372-01 2.42372-01	2.90836-01	2.9083E-01 1.1725E-01	4.78816-01	2.12426-02
	2) (	12921	5) d	P (268)	P (269)	161	P (270)	
	6.6693:-01	6.66932-11 -4.2991E-02	6.3161E-01	8.31612-01 -7.9615:-02	9.5300E-01	9.53006-01 -9.67726-02	1.0172E+00 -1.0279E-01	-1.0279E-01
FAR-FIELD PRESSURES AT THE SURFACE OF A LARGE SPHERE CENTERED AROUND THE BODY	RES AT THE SU	RFACE OF A LAK	RGE SPHERE CEN	TERED AROUND T	ME 80DY			
COLATITUDE . 0.	990							
JCN6I TUDE	Ė	3631						
	REAL	I 4AGE MARY	REAL	IMAGINARY	REAL	IMASIMARY	REAL	IMAGINARY
	6.51075-11	5.5362E+00						
COLATITUDE = 5.000E+08 DEG	80E+00 DEG							
LONGITUDE	ė	06.30	63.88	(3,00@E+010EG)	11.80	(1.800E+020EG)	(2.70	(2.788E+02DEG)
	REAL	I 4 A G I NA 2 Y	REAL	IMAGIMARY	REAL	IMASINARY	REAL	IMAGINARY
	6.67 82E-81	5.5689E+30	4.6152E-11	6.1453E+00	6.6782E-01	5.5609€+00	8.7617E-01	4.9340E+00
COLATITUDE = 1.000E+81 DEG	00E+01 DEG							
LONGITUDE	•	1930	9.8	(3.000E+010EG)	(1.80	(1.800E+02DEG)	12.70	(2.7806+02066)
	REAL	I 4AGI NARY	REAL	IMACIVARY	REAL	IMAGINARY	REAL	IMAGINARY
	7.15702-01	5.63%BE+00	3.03106-01	6.7718:+80	7.1570E-01	5.63+0E+00	1.1365E+00	4.3251E+00

CO_ATITUDE = 1.500E+01 DEG	550 10+E							
LONGITUDE	e.	1530	(3.00(	(3.000E+010EG)	(1.80	(1.800E+820EG)	(2.70	(2.700E+020EG)
	RE AL	I 4AGI NARY	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	INAGINARY
	7.95442-01	5.7530E+00	1.7.865-91	7.42203.03	7.95446-01	5.7530E+00	1.43476.00	3.69.06.00
C3_4TITUDE = 2.000:+01 0:G	95.01 056							
LONGITUDE	.6	3653	(3.00	(3.000E+010EG)	(1.800	(1.800E+020EG)	(2.78)	(2.700E+020EG)
	REAL	IMAGINARY	REAL	IMAGIMARY	REAL	IMAGINARY	REAL	IMAGINARY
	3.0682E-01	5.3140E+00	7.54885-02	8.09773+00	9.0682E-01	5.91406+00	1.77186.00	3.02516+00
COLATITUDE = 2.5002+01 02G	0E+01 0EG							
SCULINOT,	.00	0561	19.00	(3.000E+010EG)	(1.80	(1.800E+020EG)	12.78	(2.700E+020EG)
	REA.	144614437	REAL	IMAGIMARY	REAL	IMAGINARY	REAL	IMAGINARY
	1.04926+00	6.11136+00	4.0840E-03	6.79562+03	1.0492E+00	6.11136+00	2.14756+00	2.30416+00
COLATITUDE = 3.000E+01 DEG	0E+01 0EG							
LONGITUDE	.03	9631	(3.00	(3.000E+010EG)	11.800	(1.800E+02DEG)	(2.79	(2.700E+02DEG)
	RE AL	I 4AGINARY	REAL	IMAGIVARY	REAL	IMASINARY	REAL	IMAGINARY
	1.2212E+00	6.3382E+00	-+- 00246-02	00+39905*6	1.2212E+00	6.3382E+00	2.5599E+00	1.5205E+00
COLATITUDE = 3.5002+01 DEG	35+01 DEG							
LONGITUDE	.00	3661	00.60	(3.000E+010EG)	(1.000	(1.800E+020EG)	15.70	(2.700E+020EG)
	RE AL	ITAGINARY	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINARY
	1.42046+00	6.5971E+00	-5.75346-02	1.0226:+01	1.42046+00	6.58712+00	3.00506+00	6.6872c-01
COLATITUDE = 4.0005+01 DEG	05+01 05G							
LONGITUDE	.00	0,50	(3.00	(3,000E+010EG)	(1.800	(1.800E+020EG)	(2.79	(2.700E+020EG)
4 t	RE A.	ITAGENARY	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINARY
	1.54335+08	6.94932+00	-4.95142-02	1.09325+01	1.6433E+00	6.84935+00	3.4762E+00	-2.4970E-01

COLATITUDE = 4.500E+01 0EG	05.01 056							
LONGITUDE	.03	3631	(3.000	(3.000E+010EG)	(1.800	(1.800E+02DEG)	(2.70	(2.708E+02DEG)
	RE A.	I 4AGE NA 2Y	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINAR
	1.88472+00	7.11642+00	-1.77605-02	1.1613:+01	1.8847E+00	7.11642+00	3.9646E+00	-1.2253E+0
C3L4TITUDE = 5.0002+01 DEG	01.01.01							
LONGITUDE	.00	0651	(3.00	(3.000E+010EG)	(1.800	(1.800E+020EG)	(2.70	(2.700E+02DEG)
	REAL	I 4AST 4A 2Y	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINAR
	2.1381E+00	7.3795E+00	3.48662-02	1.2253:+01	2.1381E+00	7.3795E+00	4.4590E+00	-2.2400E+0
C3L4TITUDE = 5.500E+01 DEG	950 10+30							
LONGITJDE		3651	(3.000	(3.000E+010EG)	(1.800	(1.800E+02DEG)	(2.70	(2.700E+02DEG)
	REAL	I 4 A G I NA RY	REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINAR
	2.39546+38	7.6385E+88	1.04352-81	1.2839:+81	2.3954£+00	7.6305E+00	4.94696+00	-3.2676E+0
COLNTITUDE = 5.0002+01 026	05+01 056							
LONGITUDE	.00	3631	(3.00	(3.000E+010EG)	(1.600	(1.800E+020EG)	12.70	(2.780E+020EG)
	RE AL	IMAGINARY	REAL	INAGIVARY	REAL	IMGINARY	REAL	IMAGINAR
	2.64746+30	7.9521E+ 00	1.05302-01	1.3350:+01	2.6474E+00	7.86216+00	5.4108E+00	-4.2747E+8
COLATITUDE = 6.5002+01 05G	0±+01 0±6							
LONGITUDE	.00	1530	(3.00	(3.000E+010EG)	(1.800	(1.800E+820EG)	47.50	(2.700E+02DEG)
	REAL	I 4ASI NARY	REAL	INAGIVARY	REAL	IMAGINARY	REAL	IMAGINAR
	2.8841E+00	8.0683E+00	2.7131E-01	1.3804:+01	2.8841E+00	8.0680E+00	5.8381E+00	-5.2231E+0

CO.ATITUDE = 7.0005+01 05G

LONGITUDE	ė,	3651	(3.00)	(3.000E+010EG)	(1.80	(1.800E+02DEG)	(2.7)	(2.700E+020EG)
REAL	,	I 4ASI NA 2Y	REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINARY
3.0952E+10	2E+08	8.25.25E+00	3.55206-01	1.6169:011	3.0952E+00	8.24286+00	6.2128E+00	-6.0721E+00
COLVITUDE = 7.5005+01 05G	956							
LONGITUDE		365)	(3.00	(3.000E+010EG)	4.19	(1.800E+620EG)	12.21	(2.700€+820€6)
SEAL		I 4AGI NA 2Y	REAL	IMAGIMARY	REAL	IMGINARY	REAL	IMAGINARY
3.2713E+30	16+30	8.38252+00	4.3001E-01	1.44532+01	3.27136+00	0.3825E+00	6.52 07 E+00	•
C3_ATITUDE = 8.0002+01 05G	9							
LONGITUDE	:	05.50	(3.000	(3.000E+010EG)	(1.80	(1.800E+02DEG)	(2.79	(2.700E+020EG)
REAL	,	I 4AGINA 2Y	REAL	IMAGIVARY	REAL	I MAG I MA RY	REAL	IMAGINARY
3.40372+30	00+3	0.49425+00	10-20000-	1.46552.01	3.4037E+00	8.4842E+00	6.74996+00	-7.3174E+00
COLATITUDE = 0.500E+01 0EG	9							
LONSITUDE	:	3631	(3.000	(3.000E+010EG)	(1.00	(1.800E+020EG)	(2.79	(2.700E+02DEG)
SEAL	,	I 4AGINA 2Y	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINARY
3.48641	00+3	8.54602+00	5.2653E-01	1.4776:+01	3.4860E+00	8.5460E+00	6.8913€+00	-7.6507E+00
C3_4TITUDE = 3.0002+01 0EG	٥							
LONGITUDE		3661	(3.000	(3.000E+010EG)	(1.800	(1.800E+820EG)	(2.70	(2.700E+020EG)
REAL		I 4AST NARY	REAL	IMAGIVARY	REAL	IMGINARY	REAL	IMAGINARY
3.51392+00	6 • 0 0	0.55672+00	5.39485-01	1.4816:+01	3.5139E+00	8.5667E+00	6.93916+00	-7.76386+00
ELAPSED TIME AT EXIT FROM XMAVE :	* XMAVE		5.425E+02 SECO40S					

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DATA INPUT FORM (1)

## PIECEWISE CONICAL SHELL SURFACE

PROBLEM .	SAM	1PLE P	ROBLEM	2		_		DATE	OF <u>3</u>
			X	WAVE DA	TA				
NUMBER OF	REGIONS								
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1 4									
region: Ex	TENT AND MO	$\theta_1$	θ2	z,	z <sub>2</sub>	n	m	SIGN	
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NORMAL SU V <sub>n</sub> (REAL)	Vn (IMA		25	33	41	49		57	64
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REGION: EX	TENT AND M	$\theta_1$	θ <sub>2</sub>	z <sub>1</sub>	Z <sub>2</sub>	n	m	SIGN	
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1 NORMAL SU V <sub>n</sub> (REAL)	RFACE VELOC		25	33	41	49	53 5	57	64
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r1	r <sub>2</sub>	$\theta_1$	θ2	Z <sub>1</sub>	Z <sub>2</sub>	n	m	SIGN	
0.0	1.0	0.0	90.0	2.0	2,0	0006	0007	1.0	
NORMAL SU V <sub>n</sub> (REAL)	RFACE VELO		25	33	41	49	53 5	7	64
1	8 11	18							

DATA INPUT FORM (2)

FAR-FIELD PRESSUR	E CALCULATION
TITLE SAMPLE PROBLEM 2	DATE
PROBLEM	SHEET _3 OF 3
XWAVE	DATA
AUTOMATIC FAR FIELD POINT GENERATION	
NEFLAT NEFLNG LATLIM LONGLIM	
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ARBITRARY FAR-F ELD POINT SPECIFICATION	
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DATA INPUT FORM (15)

ELAPSED TIME AT ENTRY IVTO KARVE # 2,996E+ [1 SE2DMOS

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THERE ARE 0-0672(10TAL) WORDS OF OPEN-CORE AVILLAGLE FOR THIS PRODLEM

CM REDUCED TO B6259010CTAL

KAAVE SEPTEMBER 1975

The state of the s

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FENITE CYLINDER - RADIJS=1, LENGTH=4 REGID-BODY SCATTERING OF PLANE MAVE FROM Z(-) DIRECTION

DIMENSIONS FOR ARRAYS

DIMENSION 1 = 24

DIMENSION 2 = 12

DIMENSION 4 = 16

DIMENSION 5 = 9

DIMENSION 5 = 9

DIMENSION 9 = 1

DIMENSION 1 = 1

OPTION DATA

OPT 0P2 0P3 0P4 3P5 0P6 0P7 0P8 0P9 0P10

0 1 1 5 1 1 0 2 0 1

HASALTUDE OF VECTOR MAVE NUMBER, K = 2.0000E+00

COMPONENTS OF VECTOR WAVE NUMBER K

K-COMPONENT Y-COMPONENT Z-COMPONENT 0.

MAGNITUDE OF NONDIMENSIONALIZED INCIDENT PRESSURE MAYE = 1.0000:+00

SURFACE GEOMETRY AND BOUNDARY CONDITION SYMMETRIES

ROTATIONAL SYNHETRY ABOUT Z-AKIS

IT OUTWARD	POINT	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00
COORDINATES OF UNIT OUTWARD	X X Y			. 0	
8		•	•		•
AREA	ELEMENT	2.4241E-03	2.4241E-03	2.4241E-03 0.	2.4241E-03 0.
INVERSE CURVATURE	BASE POINT	. 0	•	÷	÷
SURFACE HODEL GEOMETRY SJARACE ELEMENT BASE POINT COORDINATES ELEMENT	2 ,	7.2630E-03 8.3016E-02 -2.0000E+00	2.1568E-02 8.0494E-02 -2.0000E+00	3.5218E-02 7.5526E-02 -2.0000E+00	4.779AE-02 6.9253E-02 -2.000E+00
SURFACE RECENENT BASELEMENT BASELEMENT	×	7.2630E-03	2.1568E-02	3.5218E-02	4.77985-02
SURFACE N SURFACE ELEMENT	<b>*</b> 0	-	2	8	,

-1.0000E+00	-1 .0 000 E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0000E+00	-1.0008E+30	-1.0000E+00							
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2.4241E-03	2.4241E-03	2.42416-03	2.4241E-03	2.42416-03	1.27226-03	7.2722E-03	7.2722E-03	7.2722E-03	7.2722E-03	7.2722E-03	7.27226-03	7.27226-03	7.27226-03	1.21206-02	1.21206-02	1.21206-02	1.21205-02	1.2120E-02	1.21206-02	1.21205-02	1.2120E-02
	:			:	:			:			•		•		•				0	0	•
5.8926E-02 -2.0000E+00	4.7798E-02 -2.000E+00	3.5218E-02 -2.0000E+00	2.1568E-02 -2.000E+00	7.2630E-03 -2.0000E+00	2.4905E-01 -2.0000E+00	2.41+8E-01 -2.5000E+00	2.2658E-01 -2.0000E+00	2.0479E-01 -2.0000E+00	1.7678E-01 -2.0000E+00	1.4339E-01 -2.0000E+00	1.0565E-01 -2.0000E+00	6.4705E-02 -2.0000E+00	2.1799E-02 -2.0000E+00	4.1508E-01 -2.3000E+00	4.02+7E-01 -2.0000E+00	3.7763E-01 -2.0000E+00	3.4131E-01 -2.0000E+00	2.9453E-01 -2.0000E+00	2.3899E-01 -2.0000E+00	1.7609E-01 -2.0030E+00	4.0247E-01 1.0794E-01 -2.0000E+00
5.8926E-02	6.8263E-02	7.55265-12	8.04946-02	8.3016E-02	2.1789E-02	6.4705E-02	1.0565E-01	1.43396-01	1.76785-01	2.0479E-01	2.26586-01	2.4148E-01	2.4905E-01	3.6315E-02	1.0784E-01	1.7609E-01	2.38996-01	2,9463E-01	3.4131E-01	3.7763E-01	4.0247E-01
S	٠	~		6	0.	2	12	13	=	15	91	11	91	61	02	77	22	2	12	52	9:2

6.1508E-01	3.6315E-02 -2.000E+00 5.8111E-01 -2.1000E+00		1.21206-02			-1.0000£+00
1.5098E-01	5.6346E-01 -2.0000E+00	.0	1.5968E-02		• 0	-1.0000E+00
2.4653E-01	5.2858E-01 -2.000E+00	.0	1.69685-32	.0	. 0	-1.0888E+88
3,34596-01	4.7754E-01 -2.0000E+00	. 0	1.69685-02	. 0	. 0	-1.0000E+80
4.12486-01	4.1248E-01 -2.0000E+00	.0	1.69686-02			-1.0006E+80
4.77846-01	3.3459E-01 -2.0007E+00	.0	1.6968E-02	. 0	. 0	-1.0000E+00
5.2868E-01	2.4653F-01 -2.000E+00	.0	1.6968E-02	.0	. 0	-1.0080E+80
5.5346E-31	1.5098E-01 -2.000E+00	.0	1.6968E-02			-1.0000E+00
5.81116-01	5.08+1E-02 -2.0000E+00	.0	1.6968E-02	. 0		-1.0000E+00
6.53676-12	7.4715E-01 -2.3003E+00		2.18176-02		:	-1.0000E+00
1.94116-01	7.24446-01 -2.00006+00	.0	2-1817E-02		. 0	-1.0000E+00
3.1696E-01	6.7973E-01 -2.5000E+00	••	2.18176-02			-1.0000E+88
4.3018E-01	6.1436E-01 -2.0000E+00	•0	2.18176-02	.0	. 0	-1.0000E+00
5.30336-01	5.3033E-01 -2.0000E+00	.0	2.18176-02	. 0		-1.0000E+00
6.14366-01	4.3018E-01 -2.000E+00	0.	2.18176-02	. 0	. 0	-1.0000E+00
6.79736-01	3.1695E-01 -2.0000E+00	.0	2.18176-02	. 0	. 0	-1.0000E+00
7.24446-31	1.34116-01 -2.00006+00	0.	2.18176-02	• 0	. 0	-1.0000E+00
7.47156-01	6.5357E-02 -2.0000E+00	0.	2.18176-02	. 0	0.	-1.0030E+00
7.98938-32	9.1318E-01 -2.0005E+00		2.6665E-02	. 0		-1.0000E+80
2.3725E-01	3.8543E-01 -2.0000E+00	.0	2.66656-02	. 0	• 0	-1.0000E+00
3.8740E-01	8.3078E-01 -2.0030E+00	.0	2.5665E-02	. 0	. 0	-1.0000E+00

5.2578E-01	7.5099E-01 -2,0000E+00		2.6665E-02		• • •	-1.0000E+00
	5.2578E-01 -2.000E+00	·	2.6665E-02		٠	-1.0000E+00
	3.87.4E-01 -2.0000E+00	0.	2.6665E-02			-1.0080E+00
	2.3725E-01 -2.0000E+00	0.	2.5665E-02			-1.0000E+00
	7.9893E-02 -2.860 0E+00	•	2.6665E-02		. 0	-1.0000E+00
	9.8759E-01 -1.8333E+00	2.1000E+00	1.04726-01	1.5643E-01	9.8769E-01	•
	8.9131E-01 -1.8333E+00	2.3000E+00	1.0472E-01	4.5399E-01	8.9101E-01	•
	7.07115-01 -1.03336+00	2.1000E+00	1.04726-01	7.07116-01	7.0711E-01	•
	4.5339E-01 -1.9333E+00	2.3000E+00	1.3472E-01	8.9101E-01	4.5399E-01	
9.87696-01	1.5543E-01 -1.8333E+00	2.3000E+00	1.0472E-01	9.87695-01	1.5643E-#1	
1.5643E-11	9.8759E-01 -1.5000E+00	2.1000E+00	1.0472E-01	1.5643E-01	9.87696-81	
4.5399E-01	8.3101E-01 -1.500 0E+00	2.1000E+00	1.84726-01	4.5399E-01	8.91016-01	
7.07116-01	7.0711E-01 -1.5000E+00	2.3000E+00	1.0472E-01	7.0711E-01	7.07116-01	·
8.91018-01	4.5339E-01 -1.5000E+00	2.3000E+00	1.8472E-01	8.91016-01	4.5399E-01	•
9.87696-01	1.56436-01 -1.50006+00	2.3000E+00	1.0472E-01	9.87696-01	1.5643E-01	
1.5643E-01	9.8759E-01 -1.1657E+00	2.3800E+00	1.04726-01	1.5643E-01	9.8769E-01	
4.53996-01	8.9101E-01 -1.1567E+00	2.0000E+00	1.04726-01	4.5399E-01	8.9101E-01	.0
7.07116-31	7.0711E-01 -1.1567E+00	2.3000E+00	1.04726-01	7.07116-81	7.07116-01	•
8.91016-01	4.5239E-01 -1.1667E+00	2.0000E+00	1.04726-01	8.9101E-01	4.53996-01	.0
9.876 95-01	1,5643E-01 -1,1657E+00	2.3000E+00	1.0472E-01	9.8769E-01	1.56436-01	. 0
1.56438-01	9.8759E-01 -8.3333E-01	2.1800E+00	1.04726-01	1.5643E-01	9.87695-01	.0

12	4.5399E-01		8.9101E-01 -8.3333E-01	2.0000E+00	1.0472E-01	4.5399E-01	8. 91 01E-01	•
72	7.07116-01	7.071 EE-01	-8.3338-01	2.1000E+00	1.3472E-01	7.07116-01	7.0711E-01	
2	8.91016-01	4.5339E-01	-6.333E-01	2.000E+00	1.04726-01	8.9101E-01	4.5399E-01	
2	9.87696-01	1.5643E-01	-8.333E-01	2.3000E+00	1.0472E-01	9.8769E-81	1.5643E-01	
æ	1.5643E-01	9.8759E-01	-5.0000E-01	2.000E+00	1.0472E-01	1.5643E-01	9.8769E-01	•
92	4.53996-01	8.910 fE-01	-5.0000E-01	2.0000E+00	1.04725-01	4.53996-01	8. 9101E-01	
14	7.07116-01	7.07116-01	-5.0000E-01	2.0800E+00	1.0472E-01	7.07116-01	7.07116-01	
18	8.91016-01	4.53396-01	-5.0000E-01	2.000E+00	1.8472E-01	8.9101E-01	4.5399E-01	
2	9.87696-01	1.5643E-01	-5.0000E-01	2.0000E+00	1.0472E-01	9.8769E-01	1.5643E-01	
0.6	1.5643E-01	9.8759E-01	-1.6667E-01	2.000E+00	1.0472E-01	1.5643E-01	9.87695-01	
7	4.53998-01	8.9101E-01	-1.6667E-01	2.1003E+00	1.3472E-01	4.5399E-01	8.9181E-01	
26	7.07116-01	7.07116-01	-1.6667E-01	2.1000E+00	1.0472E-01	7.07116-01	7.07116-01	
20	8.91016-01	4.53996-01	-1.6657E-01	2.3000E+00	1.0472E-01	8.91016-01	10-36665.4	
í	9.87695-01	1.5643E-01	-1.6667E-01	2.0000E+00	1.0472E-01	9.87696-01	1.5643E-01	•
50	1.5643E-01	9.87596-01	1.6667E-01	2.0000E+00	1.04726-01	1.5643E-01	9.8769E-01	
9	4.53998-81	8.91016-01	1.6667E-01	2.0000E+00	1.8472E-01	4.5399E-01	8.9101E-01	
10	7.07115-81	7.07116-01	1.6667E-01	2.0000E+00	1.0472E-01	7.07116-01	7.0711E-01	•
	8.91016-01	4.53996-01	1.6667E-01	2.3000E+00	1.0472E-01	8.9101E-01	4.5399E-01	
5	9.8769E-01	1.5643E-01	1.6667E-01	2.3000E+00	1.04726-01	9.8769E-01	1.5643E-01	
06	1.5643E-01	9.8759E-01	5.00008-01	2.1000E+00	1.04726-01	1.5643E-01	9.8769E-01	
9.1	4.5399E-01	8.91016-01	5.00006-01	2.000E+00	1.04725-01	4.5399E-01	8.9101E-01	.0
26	7.07116-01	7.8711E-01	5.0000E-01	2.0000E+00	1.04726-01	7.07116-01	7.0711E-01	

13	8.9101E-01	4.5399E-01	5.00006-01	2.1000E+00	1.04726-01	8.91016-01	4.5399E-01	:
:	9.8769E-01	1.5643E-01	5.0000E-01	2.3000E+00	1.04726-01	9.87696-01	1.5643E-01	:
36	1.5643E-01	9.8769E-01	8.3333E-01	2.3800E+00	1.0472E-01	1.5643E-01	9.8769E-01	
96	11-36655.4	8.910 RE-01	6.33336-01	2.0 000E+00	1.0472E-01	4.5399E-01	8.9101E-01	:
	7.07116-01	7.0711E-01	8.3333E-01	2.0000E+00	1.0472E-01	7.07116-01	7.07116-01	:
:	8.9101E-01	4.53996-01	8.33336-01	2.0000E+00	1.0472E-01	8.9101E-01	4.53996-01	:
£	9.8769E-01	1.5643E-01	8.333E-01	2.0000E 4.00	1.04726-01	9.87696-01	1.5643E-01	:
5	1.5643E-11	9.8759E-01	1.1667E+00	2.1000E+00	1.0472E-01	1.56436-01	9.87696-01	:
1	10-36665**	8.910 IE-01	1.1667E+00	2.0800E+00	1.04726-01	4.53936-01	8.9181E-01	:
711	7.07116-01	7.0711E-01	1.1567E+00	2.0000E+00	1.0472E-01	7.07116-01	7.07116-01	:
21	8.91016-01	4.5399E-01	1.1567€+00	2.0000000	1.0472E-01	8.9101E-01	4.5399E-01	:
187	9.876 9€-01	1.5643E-01	1.1557E+00	2.0000E+00	1.0472E-01	9.87696-01	1.5643E-01	:
5	1.5643E-01	9.8769E-01	1.5000E+00	2.3000E+00	1.04726-01	1.5643E-01	9.87696-01	:
\$	4.5399E-01	8.918 E-01	1.5000E+00	2.0000E+00	1.04726-01	4.53996-01	0. 91 01E-01	:
•	7.07116-01	7.071 FE-01	1.5000E+0C	2.0000E+00	1.04726-01	7.07116-01	7.07116-01	:
:	8.91816-81	4.5399E-01	1.5000E+00	2.1000E+00	1.04726-01	8.9101E-01	4.5399E-01	:
61	9.87696-01	1.5643E-01	1.5000E+00	2.3000E+00	1.04726-01	9.8769E-01	1.5643E-81	:
110	1.5643E-81	9.8769E-01	1.63336+00	2.0000E+00	1.04726-01	1.5643E-01	9.8769E-81	:
=	11-3685-11	8.9101E-01	1.833E+00	2.3000E+00	1.04726-01	4.53996-01	8.9181E-01	:
211	7.0711E-01	7.07116-01	1.6333E+00	2.0000E+00	1.04726-01	7.07116-01	7.0711E-01	:
1113	8.9101E-01	4.5339E-01	1.8'333E+00	2.0808E+00	1.04726-01	8.91 B1E - 01	4.5399E-01	:
*11	9.87696-01	9.8769E-01 1.5643E-01 1.8333E+00	1.833E+00	2.3888E+00	1.8472E-01	9.8769E-01 1.5643E-01		:

1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.000E+00	1.000E+00	1.0000E.00	1.0000E+10	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+80	1.0000E+00
:	:	•	:	:	:	:		•	:	•	•	:	:	:	•	:	:	:	:		:
:	÷	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
2.4241E-03	2.42416-03	2.4241E-03	2.4241E-03	2.4241E-03	2.4241E-03	2.4241E-03	2.42416-03	2.4241E-83	7.2722E-03	7.2722E-03	7.27226-03	7.27226-03	7.2722E-03	7.27226-03	7.27226-03	7.27226-03	7.27226-03	1.21206-02	1.21206-02	1.21206-02	1.2120E-02
•	·	•			•			:			•		•	•			•	.0	.0	•	
2 • 000 0E • 00	2.0000E+00	2.0000E+00	2.0000E+00	2.0000E+00	2 • 0 0 0 0E + 0 0	2. 1000E+00	2.0000E+00	2.0000E+00	2.0000E+00	2.000E+00	2.0000E+00	2.00006+00	2. C000E+00	2.0000E+00	2.1000E+00	2.0000E+00	2. C000E+00	2.0000E+00	2.0000E+00	2.000E+00	2.0000E+00
8.3016E-02 2.0000E+00	8.34946-02	7.5526E-02	6.8253E-02	5.8926E-02	4.77986-02	3.5218E-02	2.1568E-02	7.2630E-03	2.4905E-01	2.41+8E-01	2.2658E-01	2.04796-01	1.76786-01	1.43396-01	1.0565E-01	6.4705E-02	2.17896-02	4.1538E-01	4.0247E-01	3.77536-01	3.4131E-01 2.0000E+00
7.2630E-03	2.1568E-12	3.5218E-02	4.77985-02	5.8926E-02	6.82635-02	7.5526E-02	8.04945-02	8.3016E-02	2.17895-02	6.4705E-02	1.0565E-01	1.43396-01	1.7678E-01	2.0479E-01	2.2658E-01	2.4148E-01	2.4905E-01	3.63156-02	1.07846-01	1.76096-01	2.38996-01
11.5	911	111	118	611	021	121	221	123	121	521	921	121	921	621	130	131	132	133	134	135	136

137 2	.9463E-01	2.9463E-01 2.9453E-01	2. CD 0 0 E + 00	·	1.21206-02		:	1.0000E+00
m	3.4131E-01	2.38996-01	2 * 0 0 0 0E + 0 0	•	1.2120E-92	:		1.0000E+00
~	3.77636-01	1.76095-01	2. C000E+00	•	1.21206-02		:	1.0000E+00
,	4.0247E-01	1.07946-01	2.0000E+00	•	1.2120E-02	•	•	1.0000E+00
,	4.1508E-01	3.6315E-02	2. 0000E+00	•	1.2120E-02	•		1.0000E+00
ır	5.0841E-02	5.81116-01	2.3000E+00	•	1.6968E-02	•	:	1.0000E+00
-	1.50986-01	5.63466-01	2.0000E+00	•	1.69686-02	•	:	1.0000E+00
2	2.4653E-01	5.2868E-01	2.0000E+00		1.6968 - 02	:	:	1.0000E+00
-,	3,34596-01	4.77846-01	2.0000E+00		1.6968E-02	:	:	1.0000E+00
,	4.1248E-01	4.1248E-01	2.000E+00		1.6968E-02	:	:	1.0000E+00
,	4.7784E-01	3.34596-01	2.0000E+00		1.6968E-02	:	:	1.0000E+00
r	5.28686-01	2.4653E-01	2.0000E+00	•	1.6968E-02		:	1.0000E+00
r.	5.6346E-01	1.50985-01	2.0000E+00	:	1.6968E-02	:	:	1.0000E+00
u,	5.81116-01	5.0841E-02	2. 000 0E + 00	:	1.6968E-02	:	:	1.0000E+00
•	6.536 Æ-02	7.47156-01	2. C00 0E+00	÷	2.1817E-02	:	:	1.0000E+00
-	1.94116-01	7.24445-01	2.0000E+00	:	2.1817E-02	•	:	1.0000E+00
m	3.16966-01	6.7973E-01	2.0000E+00	:	2-18175-02	:	:	1.0000E+00
•	4.30186-01	6.1436E-01	2.0000E+00		2.1817E-02	:	:	1.0000E+00
r	5.30336-01	5.30336-01	2.0000E+00	:	2.1817E-02	:	:	1.0000E+00
9	6.1436E-01	4.3018E-01	2.0000E+00	:	2.1817E-02	•	:	1.0000E+00
· ·	6.7973E-01	3.16366-01	2.0000E+00	:	2.18176-02	:	:	1.0000E+00
-	.2444E-01	7.2444E-01 1.941KE-01 2.0000E+00	2.0000E+00	÷	2.1817E-02	:	:	1.0000E+00

ž	7.47156-01	7.4715E-01 6.5367E-02 2.0000E+00	2.0000E+00		2.1817E-02 0.			1.0000E+00
3	7.98936-02	7.9893E-02 9.1318E-01 2.0000E+00	2.0000E+00		2.6665E-02		•	1.0000E+00
	2.37256-01	2.3725E-01 8.85+3E-01 2.0000E+00	2.0000E+00		2.6665E-02	•	• 0	1.0000E+00
ä	3.87406-01	3.8740E-01 8.3078E-01 2.8000E+00	2. 800 0E +00	•	2.6665E-02		.0	1.0000E+00
3	5.2578E-81	5.2578E-81 7.5089E-81 2.8000E+80	2.8000E+00		2.6665E-02	•		1.0000E+00
3	6.48185-01	6.4818E-01 6.4818E-01 2.0000E+00	2.0000E+00	•	2.6665E-02	. 0	•	1.0000E+00
ž	7.50896-01	7.5089E-01 5.2578E-01 2.0000E+00	2.000 0E+00		2.6665E-12			1.0000E+00
3	8.30786-01	8.3078E-01 3.8740E-01 2.0000E+00	2.0000E+00	.0	2.6665E-02	. 0	•	1.0000E+00
ä	8.8543E-01	8.85%3E-01 2.3725E-01 2.0000E+00	2.0000E+00		2.6665E-02		:	1.0000E+00
3	9.13186-01	9.1318E-01 7.9893E-02 2.0000E+00	2.0000E+00	.0	2.6665E-02			1.0000E+00

SURFACE NORMAL VELOCITY BOJNDARY CONDITION

SURFACE JELOCITIES ( REAL PART, IMAGINARY PART )

REGLON = 1								
	*	44 10	•	#C 10)	V ( 19)	161	VC 281	
	6.5364E-01	6.5364E-01 -7.5680E-01	6.5364E-81	6.5364E-81 -7.5680:-01	6.5364E-01	6.5364E-01 -7.5680E-01	6.5364E-01 -7.5680E-01	.5680E-01
		11 371	-	16 46)				
	6.5364E-01	6.5364E-01 -7.5680E-01	6.5364E-81	6.5364E-01 -7.5680:-01				
REGION = 2								
	;	16 551		4( 60)	V( 65)	151	VC 701	
	:	÷				•	•	
	;	16 75)	-	(00)	V C 853	151	106 37	
	•	•	.0			:		
	**	156 14	4.03	W(100)	V (105)	151	V(110)	
	:	•				•		
REGEON = 3								
		V(115)	10.4	4(124)	V (133)	33)	V (142)	
	-6.5364E-01	-6.5364E-01 -7.5580E-01	-6. 5364E-81	-6.5364E-01 -7.5680E-01	-6.5364E-01	-6.5364E-01 -7.5680E-01	-6.5364E-01 -7.5680E-01	. 56 80E-01
	•	V(151)	10.4	W(160)				
	-6.5364E-01	-6.5364E-01 -7.5680E-01 -6.5364E-01 -7.5680:-01	-6. 5364E-81	-7.56805-01				

ENTER SUBROUTINE FOR ITERATIVE SOLUTION FOR SURFACE PRESSURE

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REQUESTED LIMIT ON NUMBER OF ITERATIONS = 30

RELAXATION FACTOR SPECIFIED IS

REAL PART IMAGINARY PART 5.0000E-01 3.

CONVERGENCE CRITERION = 1.0000E-04

BEGIN ITERATION

TIME = 4.226E+01 SECONDS

MAXINUM DIFFERENCE BETWEEN COMPONENTS

OF SUCCESSIVE VECTORS 1.8481E+88

3.4754=-01

2.10435-01

1.29605-01

1.3462:-01

1.17036-01 8.5600E-02

5.3122E-02

2.8505E-02

1.8429E-02 1.30725-02 1.16416-02

1.11815-02 9.55446-33 7.3652E-03

5.18455-03 3.41375-03 2.5287E-03

1.93446-03 1.60095-03 1.4412E-03

1.2180E-03 9.5654E-04 7.0552E-04 5.0331E-04 3.6766E-04 2.4205E-04 2.4205E-04 1.6682E-04

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ITERATION TERMINATED BY LIMIT ON NO. OF ITERATIONS SEING MET

TIME AT TERMINATION IS 4.612E+C1 SECONDS

## SURFACE PRESSURES! REAL PART, IMAGINARY PART

3.4097E-01 -1.0156E-01 2.0500E-01 3.9656E-02 4.0679E-02 7.4558E-02 -9.9925E-02 6.8821E-02 3.0967E-02 3.5224E-02 1.5617E-01 1.0304E-02 2.3004E-01 -4.8122E-02 2.0528E-81 -1.4546E-81 1.6994E-82 -2.7502E-01 8.8563E-02 -1.7973:+00 1.0871E-01 -1.6320E+00 1.2243E-01 -1.4107E+00 P(110) P.C 703 P( 28) -1.7445E-01 4.3429:-02 -9.4703E-02 4.0864E-02 P (105) P ( 85) P( 65) P( 19) 1.4885E-01 -1.1321E+00 2.6677E-01 -8.0614E-01 . (100) P( 10) 194 14 P( 80) (09) 1.95295-02 -1.93515.00 -1.7812E-01 5.3238E-02 156 16 2( 1) 11 371 152 ) 6 155 ) 0 REGION = 2

RESTON = 3

-2.0488E+08 -3.5180E-01 -1.8965E+00 -3.9437E-01 -1.7181E+00 -3.7918E-01 -1.4794E+00 -3.4465E-01 P(142) P (133) -1.1760E+00 -3.0946E-01 -7.9700E-81 -3.4154E-01 P (124) P(150) 2(115)

REGION = 1

FAR-FIELD PRESSURES AT THE SURFACE OF A LARGE SPHERE CENTERED AROUND THE BOOT

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		IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY					IMAGINARY	
		REAL				REAL				REAL				REAL					REAL	
		IMAGINARY				IMAGINARY				IMAGINARY				IMAGIMARY					IMAGINARY	
		REAL				REAL				REAL				REAL					REAL	
		IMAGIMARY				IMAGINARY				IMAGINARY				IMAGINARY					IMAGINARY	
		REAL				REAL				REAL				REAL					REAL	
	366	IMAGINARY	-4.4740E+00		0550	IMAGINARY	-4. \$ \$ 00£ + 00		0663	IMAGINARY	-4.3782E+00		05.63	IMAGIMARY	-4.2585E+00			0560	IMAGINARY	5.5911E+00 -4.0913E+00
930	.00	REAL	6.71746+00	00E+00 DEG	ę	REAL	00+3/60/-9	00E+00 DEG	.00	REAL	5.6864E+00	00E+00 DEG	.00	RE AL	6.6471E+00	330 00 00	200		REAL	5.59116+00
COLATITUDE = 0.	LONGITUDE			COLATITUDE = 2.000E+00 DEG	LONGI TUDE			COLMITUDE = 4.000E+00 DEG	LONGI TUDE			COLATITUDE = 6.000E+00 DEG	LONGITUDE			DE TENTE DE LA PORTE DEPARTE DE LA PORTE DE LA PORTE D	במרינון ומחב - פיי	LONGITUDE		

COLATITUDE = 1.000E+01 DEG

	IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				THACTNABY	
	REAL				REAL				REAL				REAL				REAL	
	IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY	
	REAL				REAL				REAL				REAL				REAL	
	IMAGINARY				IMAGINARY				IMAGIMARE				IMACIVARY				IMAGINARY	
	REAL				REAL				REAL				REAL				REAL	
0550	IMAGIMARY	-3.8767E+00		3663	IMAGINARY	-3.6154E+00		0560	IMAGINARY	-3.3081E+00		0664	IMAGINARY	-2.95601+00		056)	IMAGIMARY	-2.5600E+00
.6.	REAL	6.5174E+00	10E+01 DEG	.00	REAL	6.4249E+00	0E+01 DEG		REAL	6.3122E+00	06+01 066	.03	REAL	6.1782E+00	0E+01 DEG	;	REAL	6.0214E+00
LONGI TUDE			COLATITUDE = 1.200E+01 DEG	LONGITUDE			COLATITUDE = 1.400E+01 DEG	LONGITUDE			COLWIITUDE * 1.500E+01 DEG	LONGI TUDE			COLATITUDE * 1.800E+01 DEG	LONGITUDE		

REAL REAL REAL REAL REAL IMAGINARY IMAGINARY IMAGINARY IMAGINARY IMAGINARY REAL REAL REAL REAL REAL IMAGINARY IMAGINARY IMAGINARY IMAGINARY IMAGINARY REAL REAL REAL REAL REAL IMAGTNARY 1.13176+00 1.7266E+00 IMAGINARY IMAGENARY 2.3157E+00 IMAGINARY 2.8896E+00 2.7125E+00 3.4382E+00 IMAGINARY (930 0.663 DEGI DEGI 4.2247E+00 3.4996E+00 3.87176+00 3.11196+00 .03 COLATITUDE = 3.200E+01 DEG COLATITUDE = 3.403E+01 DEG CO.MITTUDE = 3.603E+01 DEG .03 .00 RE AL COLATITUDE = 3.800E+01 DEG REAL COLATITUDE = 4.000E+01 0EG REAL REAL LONGI TUDE LONGI TUDE LONGI TUDE LONGITUDE LONGI TUDE

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COL*ITUDE
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
11446114RY 100 3.9513E+00 1. JEG) 1. HAGINARY 100 4.6303E+00 1. HAGINARY 100 5.1763E+00 11461NRY 11461NRY 11565
REAL 2.3061E+00 2.3061E+00 2.3061E+00 TUDE (0.  REAL 1.8976E+00 1.4925E+00 1.4925E+00 1.4925E+00 1.4925E+00 REAL 1.0965E+00 8EAL 1.0965E+00 5.000E+01 DEG 1.0965E+00
TUDE  - 4.600E4  - 4.600E4  - 5.603E4  - 5.603E4

	REAL		REAL		REAL		REAL		REAL
	IMAGINARY		IMAGINARY		IMAGINARY		IMAGIMARY		IMAGINARY
	REAL		REAL		REAL		REAL		REAL
	IMAGINARY		IMAGICARY		IMAGITARY		IMAGIMARY		IMAGINARY
	REAL		REAL		REAL		REAL		REAL
0663	IMAGINARY 5.7390E+00		IMAGINARY 5.7470£+00	066)	I4AGINARY 5.6587E+00	056.	EMAGENARY 5.473PE+00	DEG)	IMAGINARY 5.1919E+00
COLATITUDE = 5.400E+01 DEC	REAL 2.0752E-02	COLATITUDE = 5.600E+01 DEG	REA -2.8249	COLATITUDE = 5.8005+01 DEG LONGITUDE (0.	PEAL -5.5027E-01	COLATITUDE = 6.000E+01 0EG LOMSITUDE (0.	REAL -7.7900E-01	COLMIITUDE = 6.200E+01 DEG LOMGITUDE (0.	REAL -9.6602E-01

IMAGINARY

IMAGINARY

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COLATITUDE = 6.400E+01 DEG							
LONGITUDE (0.	0561						
REAL	IMAGINARY	REAL	IMAGIWARY	REAL	IMAGINARY	REAL	IMAGINA
-1.10975+00	4.8180£+00						
COLATITUDE = 6.600E+01 0EG							
LONGITUDE (0.	056)						
REAL	IMAGINARY	REAL	IMAGIVARY	REAL	IMAGINARY	REAL	IMAGINA
-1.2097E+00	4.3573E+00						
COLATITUDE = 6.800E+01 DEG							
LONGI TUDE	0563						
REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINA
-1.2666E+10	3.8177E+00						
GOLATITUDE = 7.003E+01 DEG							
LONGI TUDE (0.	0.56.0						
REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINA
-1.28235+00	3.2089E+00						
COLMTITUDE = 7.200E+01 DES							
LONGITUDE (0.	0563						
REAL	IMAGINARY	REAL	IMAGIWARY	REAL	IMAGINARY	REAL	IMAGINA
-1.2598E+00	2.542AE+00						
COLATITUDE = 7.401E+01 DEG							
LONGITUDE (0.	056.1						
REAL -1.20345+00	IMAGINARY 1.8327E+00	REAL	IMAGINARY	REAL	IMAGINARY	REAL	IMAGINA

		IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY	
		REAL				REAL				REAL				REAL				REAL	
		IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY	
		REAL				REAL				REAL				REAL				REAL	
		IMAGIWARY				IMAGIWARY				IMAGINARY				IMAGIWARY				IMAGIWARY	
		REAL				REAL				RE AL				RE AL				RE AL	
	066)	IMAGINARY	1.0931E+00		0561	THAGENARY	3.3967€-01		0563	IMAGTNARY	-4.11608-01		056)	IMAGTWARY	-1.144E+00		DEGI	IMAGTNARY	-1.8428E+08
E+01 DEG	.03	REAL	-1.11795+00	E+01 DEG	.00	REAL	-1.0094E+00	1E+01 DES	.03	REAL	-8.84068-01	1E+01 0EG	.00	REAL	-7.4886E-01	0E+01 0EG	.03	REAL	-6.10765-01
COLMTITUDE = 7.6015+01 DEG	LONGITUDE			COLMTITUDE = 7.803E+01 DEG	LONGITUDE			COLMITTUDE = 8.000E+01 DES	LONGITUDE		•	COLATITUDE = 8.200E+01 DEG	LONGI TUDE			:0LRTITUDE = 8.400E+01 DEG	LONGITUDE		

IMAGIMARY	IHAGINARY	IHAGINARY	IN A G I N'ARRY	IMAGINARY	IMAGINARY
REAL	REAL	REAL	REAL	REAL	REAL
IMAGINARY	IMAGINARY	IMAGINARY	IMAGINA RY	IMAGINARY	IMAGINARY
REAL	REAL	REAL	REAL	REAL	REAL
IM AG IM ARW	IMAGINARY	INAGINARY	IMAGIMARY	IMA GINARY	IMAGINARY
FE AL	REAL	FEAL	REAL	REAL	REAL
DEG) IMAGTNARY -2.49156+00	DEG) IMAGTNARY -3.0761E+00	DEG) IMAGINARY -3.5639E+00	0EG) IMAGENARY -4.0035E+00	DEG) IMAGINARY -4.3261E+00	DEE) IMAGINARY -4.5447E+00
. :	COLATITUDE = 8.800E+01 DEG LONGITUDE (0.	COLMITTUDE = 9.000E+01 DEG  LONGITUDE  REAL  -2.4649E-01  COLMITTUDE = 9.200E+01 DEG	LOMGITUDE REAL -1.5188E-01 COLRTITUDE = 9.400E+01 DEG	REAL -1.0385E-0f0.00141IUDE = 9.600E+01.0EG	LONGITUDE (0. REAL -7.5851E-02 ·

COLMITTUDE = 9.800E+91 DEG

	IL IMAGINARY				AL IMAGINARY				AL IMAGINARY				AL IMAGINARY					REAL IMAGINARY	
	REAL				REAL				REAL				REAL						
	IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY					IMAGINARY	
	REAL				REAL				REAL				REAL					REAL	
	IMAGINARY				IMAGINARY				IMAGINARY				IMAGIWARY					IMAGIWARY	
	REAL				RE AL				REAL				REAL					REAL	
056)	IMAGINARY	-4.6544E+00		0663	IMAGINARY	-4.6548E+00		066)	IMAGINARY	-4.54486+00		0661	IMAGINARY	-4.328BE+00			0661	IMAGINARY	-4.60976+00
LONGITUDE (0.	REAL	-8.0162E-82	COLMIITUDE = 1.000E+02 DEG	LONGI TUDE 19.	REAL	-1.1786E-01	COLBITTUDE = 1.020E+02 DEG	LONGI TUDE (10.	REAL	-1.8878E-01	COLMIITUDE × 1.040E+02 DEG	LOWGITUDE (0.	REAL	-2.9154E-01	230 6043636	COLORI TUDE = 1. USUE VIZ UEU	LONGI TUDE (10.	PEAL	-4.73545-81

		IMAGINA				IMAGINA				IMAGINA				IMAGINA				IMAGINA					IMAGINA	
		REAL				REAL				REAL				REAL				RE AL					REAL	
		IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY					IMAGINARY	
		REAL				REAL				REAL.				REAL				REAL					REAL	
	0.56.	IMAGTNARY	-3.5976E+00		066)	IMAGINARY	-3.101CE+00		0560	IMAGINARY	-2.5311E+00		3563	IMAGINARY	-1.9002E+00		DECI	IMAGINARY	-1.2219E+00			DEGI	IMAGINARY	-5.100#E-01
COLATITUDE = 1.080E+02 DEG	LONGITUDE 10.	REAL	10-36718*5-	COLATITUDE = 1.100E+02 DEG	LONGI TUBE (0.	REAL	-7.6063E-01	COLATITUDE = 1.120E+02 DEG	LONGITUBE (9.	REAL	10-39865-01	COLATITUDE = 1.143E+02 DEG	LONGITUDE (0.	RE AL	-1.1614E+00	COLATITUDE = 1.159E+02 DES	LONGI TUDE (1).	REAL	-1.3713E+00	COLATTINE = 1.4805402 OFC	000 00000000000000000000000000000000000	LONGITUDE (0.	PEAL	-1.5791E+00

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COLATITUDE = 1.200E+02 DEG

	IMAGINARY				2001				20411241					T THE T THE T				IMAGINARY
	REAL				86.41				954				1430				4	KEAL
	IMAGINARY				IMGINARY				IMAGINARY				IMAGINARY				MANTONI	
	REAL				REAL				REAL				REAL				REAL	
	IMAGINARY				IMAGINARY				IMAGINARY				IMAGINARY				IHAGINARY	
	REAL				REAL				REAL				REAL				REAL	
056)	IMAGINARY	2.2117E-01		DEGD	IMAGINARY	9.5784E-01		NE63	IMAGINARY	1.6865E+00		066)	IMAGINARY	2.3947E+00		056)	IMAGINARY	3.0709E+00
LONGITUDE (3.	REAL	-1.77905+00	COL4TITUDE = 1.220E+02 DEG	LONGITUDE (0.	REAL	-1.9649E+00	COLMITTUDE = 1.240E+02 DEG	LONGI TUDE (0.	REAL	-2.13155+00	COLMTITUDE = 1.260E+02 DEG	LONGITUDE (0.	REAL	-2.2741E+00	COLATITUDE = 1.280E+02 DEG	LONGITUDE (0.	REAL	-2.3688E+00

COLATITUDE = 1.300E 402 DEG

	IMAGINARY		IHAGIHARY			IMAGINARY			IMAGINARY			IMAGINARY			IMAGINARY
	REAL		REAL			REAL			REAL			REAL			REAL
	IMAGINARY		IMAGINARY			IMAGINARY			IMAGINARY			IMAGINARY			IMAGINARY
	REAL		REAL			REAL			REAL			REAL			REAL
	IMAGIMARY		IMAGIWARY			INAGINARY			IMAGINARY			IMAGIMARY			IMAGINARY
	REAL		REAL			KEAL			REAL			REAL			REAL
0663	IMAGINARY 3.7053E+00	0569	IHAGINARY 4.2894E+00		056)	4.8165E+00		0.663	IMAGINARY 5.2817E+00		DEFS	IMAGINARY 5.5819E+00		056)	IMAGINARY 6-0157E+00
69.	REAL -2.4723E+08	02 056	REAL -2.5226E+08	.0E+02 055	•	-2.5383E+00	0E+02 0EG	:0	REAL -2.5193E+00	0E+02 DEG	.00	REAL -2.466 0E+00	0E+02 0EG	:	PEAL -2.3800E+09
LONGITUDE		COLATITUDE = 1. 27 TO 2 DEG		COLATITUDE = 1.340E+02 PSS	L ONGI 711 DE		COLATITUDE = 1.360E+02 DEG	LONGITUDE		COLMIITUDE = 1.380E+02 DEG	LONGI TUDE		COLMITTUDE = 1.400E+02 DEG	LONGITUDE	

LOWGITUDE   1.4.0E+02 DEG    -2.2535E+08   6.2334E+00	-1.7628E+88 6.714NE+00 COLMITUDE = 1.500E+02 DE6 LONGITUDE (0. DE5) REAL IMAGINARY REAL IMAGINARY REAL IMAGINARY -1.5583E+08 6.7483E+08	
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IMAGINARY IMAGINARY IMAGINARY IMAGINARY IMAGINARY IMAGINARY REAL REAL REAL REAL REAL REAL IMAGINARY IMAGINARY INA GI WARY IMAGINARY IMAGINARY IMAGINARY RE AL REAL REAL REAL REAL REAL IMAGINARY 6.7367E+00 IMAGINARY 6.6862E+ 00 IMAGINARY 6.6038E+00 IMAGINARY 6.49645+00 IMAGTNARY 6.3710E+00 THAGENARY 5.2385F + 00 056) OEGI 0563 056) 0560 DEF -1.3420E+00 -1.1184E+00 -8.9196E-01 -6.6681E-01 -4.4707E-01 .00 -243655E-01 .00 .01 .03 COLATITUDE = 1. 520E+02 DEG REAL COLATITUDE = 1.560E+02 DEG COLATITUDE = 1.540E+02 DEG REAL COLATITUDE = 1.580E+02 DEG .03 .03 REAL REAL COLATITUDE = 1.6005+02 DEG REAL COLATITUDE = 1.620E+92 DEG RE AL LONGT TUDE LONGI TUDE LONGITUDE LONGI TUDE LONGITUDE LONGITUDE

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COLATITUDE = 1.640E+02 DEG

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	REAL				1838								4	1			į	KEAL
	IMAGINARY				IMAGINARY				THACTMAN				NA CAMPO				S S S S S S S S S S S S S S S S S S S	- A COUNTY OF THE COUNTY OF TH
	REAL				REAL				REAL				REAL				PF AL	
	IMAGINARY				IMAGINARY				IMAGIWARY				IMAGINARY				IMAGIMARY	
	REAL				REAL				REAL				REAL				REAL	
05.01	IMAGINARY	6.0936£+00		0561	IMAGINARY	5.9540£+00		0663	IMAGINARY	5.8214E+ 00		0661	IMAGINARY	5.7007E+00		0563	IMAGTNARY	5.5960E+00
LONGI TUDE (0.	REAL	-3.87296-02	COLATITUDE = 1.660E+02 DEG	LONGI TUDE (0.	REAL	1.43225-01	COL&TITUDE = 1.680E+02 DEG	LONGITUDE (0.	REAL	3.0652E-01	COLNTITUDE = 1.700E+02 DEG	LONGI TUDE (0.	REAL	4.4874E-01	COLMITTUDE = 1,720E+02 DEG	LONGITUDE 10.	REAL	5.6785E-01

COLMTITUDE = 1.740E+02 DES

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IMAGINARY			IMAGINARY		HAGINAR	
REAL			REAL		REAL	
IMAGINARY			IMAGINARY		IMAGINARY	
REAL			REAL		REAL	
IMAGIWARY			IMAGIWARY		IMAGIMARY	
REAL			REAL		REAL	
REAL IMAGINARY 6.6219E-01 5.5117F+00		066)	IMAGINARY 5.4487E+00		DEGI	5.4097E+00
REAL 6.6219E-01	COLATITUDE = 1.760E+02 DES	LONGITUDE (1).	REAL 7.304AE-01	780E+02	LONGITUDE (U.	7.71A2E-31 COLATITUDE = 1.A00E+02 DEG

ELAPSED TIME AT EXIT FROM XMAVE = 8.619E+01 SECONDS

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THAGINARY 5.396RE+00

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DEGI

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